DEPARTMENT OF THE NAVY
FISCAL YEAR (FY) 2004/2005
BIENNIAL BUDGET ESTIMATES

JUSTIFICATION OF ESTIMATES
FEBRUARY 2003

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

Department of the Navy

FY 2004/2005 R D T E Program — Exhibit R-1

APPROPRIATION: 1319n Research, Development, Test, and Evaluation, Navy — DATE: February 2003

LINE NO	PROGRAM ELEMENT NUMBER	ITEM NOMENCLATURE	BA	Millions of Dollars FY 2002	FY 2003	FY 2004	FY 2005	SEC
1	0601103N	University Research Initiatives	01	0.000	0.000	70.669	76.843	U
2	0601152N	In-House Laboratory Independent Research	01	16.095	15.992	17.400	17.745	U
3	0601153N	Defense Research Sciences	01	378.742	396.330	368.517	377.223	U
TOTAL	Basic Research			394.837	412.322	456.586	471.811	

LINE NO	PROGRAM ELEMENT NUMBER	ITEM NOMENCLATURE	BA	Millions of Dollars FY 2002	FY 2003	FY 2004	FY 2005	SEC
4	0602114N	Power Projection Applied Research	02	86.004	105.324	114.144	107.260	U
5	0602123N	Force Protection Applied Research	02	133.261	118.413	75.909	98.763	U
6	0602131M	MARINE CORPS LANDING FORCE TECHNOLOGY	02	27.610	29.568	31.778	35.562	U
7	0602232N	Communications, Command and Control, Intellig	02	0.000	1.368	0.000	0.000	U
8	0602233N	Human Systems Technology	02	2.498	1.027	0.000	0.000	U
9	0602234N	Materials, Electronics and Computer Technolog	02	18.591	9.780	0.000	0.000	U
10	0602235N	Common Picture Applied Research	02	122.933	148.222	59.022	70.120	U
11	0602236N	Warfighter Sustainment Applied Research	02	107.343	106.745	52.213	59.157	U
12	0602271N	RF Systems Applied Research	02	58.922	74.208	44.019	51.415	U
13	0602435N	Ocean Warfighting Environment Applied Researc	02	60.549	71.027	48.785	63.729	U
14	0602633N	Undersea Warfare Weaponry Technology	02	1.635	0.000	0.000	0.000	U
15	0602747N	Undersea Warfare Applied Research	02	72.511	84.496	62.583	66.353	U
16	0602782N	Mine and Expeditionary Warfare Applied Resear	02	54.379	55.531	47.490	48.315	U
17	0602805N	Dual Use Science and Technology Program	02	9.003	0.000	0.000	0.000	U
TOTAL	Applied Research			755.239	805.709	535.943	600.674	

LINE NO	PROGRAM ELEMENT NUMBER	ITEM NOMENCLATURE	BA	Millions of Dollars FY 2002	FY 2003	FY 2004	FY 2005	SEC
18	0603114N	Power Projection Advanced Technology	03	120.080	164.854	173.478	188.028	U
19	0603123N	Force Protection Advanced Technology	03	134.154	86.270	55.780	82.554	U
20	0603235N	Common Picture Advanced Technology	03	51.521	47.262	69.194	73.620	U
21	0603236N	Warfighter Sustainment Advanced Technology	03	72.907	96.320	54.794	56.053	U
22	0603271N	RF Systems Advanced Technology	03	73.781	74.433	45.475	36.571	U
23	0603508N	Surface Ship & Submarine HM&E Advanced Techno	03	2.898	0.000	0.000	0.000	U
24	0603640M	MC Advanced Technology Demo	03	64.373	74.970	56.404	58.446	U
25	0603706N	Medical Development	03	56.748	0.000	0.000	0.000	U
26	0603707N	Manpower, Personnel and Training Adv Tech Dev	03	1.921	0.000	0.000	0.000	U
27	0603712N	Environmental Quality & Logistics Adv Tech	03	1.348	0.977	0.000	0.000	U
28	0603727N	Joint Experimentation	03	99.996	95.512	151.058	162.105	U
29	0603729N	Warfighter Protection Advanced Technology	03	23.822	39.058	11.435	12.362	U
30	0603747N	Undersea Warfare Advanced Technology	03	51.517	43.641	38.168	45.475	U
31	0603757N	Joint Warfare Experiments	03	0.000	0.000	13.684	14.292	U
32	0603758N	Navy Warfighting Experiments and Demonstratio	03	46.024	42.501	20.584	17.992	U
33	0603782N	Mine and Expeditionary Warfare Adv Technology	03	46.405	44.985	31.719	30.081	U
34	0603792N	Advanced Technology Transition	03	0.000	2.445	0.000	0.000	U
TOTAL	Advanced Technology Development			847.495	813.228	721.773	777.579	

Fiscal Year 2004/2005 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, **[**$13,946,085,000**]** *$14,106,653,000*, to remain available for obligation until September 30, **[**2004**]** *2005*: *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, 2003.)*

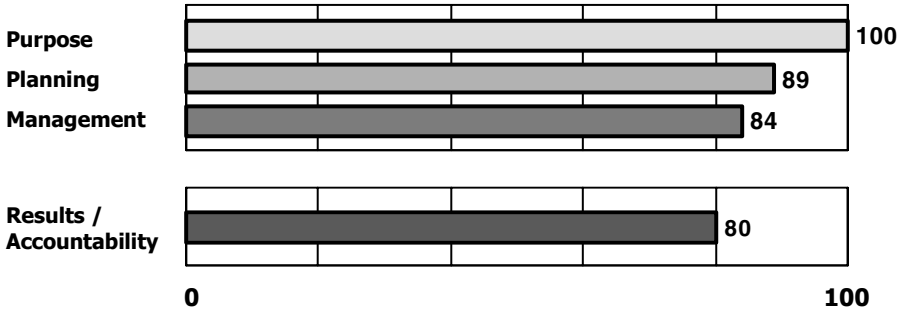
PROGRAM ASSESSMENT RATING TOOL (PART)

This year, the Administration undertook a comprehensive review of 20% of the programs of the Executive Branch, including the same portion of programs within the Department of Defense. The Basic Research programs of the Department were reviewed as a whole, including Basic Research programs of the Navy. The Basic Research program merited a rating of "Effective". A summary sheet describing the rating from the Basic Research evaluation follows.

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)

2002 Actual	**2003 Estimate**	**2004 Estimate**
1,334	1,417	1,309

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 1 PROGRAM ELEMENT: 0601103N
PROGRAM ELEMENT TITLE: University Research Initiatives

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
University Research Initiatives	0	0	70,669	76,843	72,229	68,167	69,730	70,978

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The 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 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. The program provides the knowledge base, scientific concepts, and technological advances for the maintenance of naval power and national security.

B. PROGRAM CHANGE SUMMARY: The program was transferred from the RDT&E, Defense Wide University Research Initiative, PE 0601103D8Z.

PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Submission:	0	0	0	0
Transfer into Navy S & T:	0	0	72,300	78,500
Payraise/Inflation Adjustment			-1,631	-1,657
FY 2004/2005 President's Budget Submission:	0	0	70,669	76,843

PROGRAM CHANGE SUMMARY EXPLANATION:

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 1 PROGRAM ELEMENT: 0601103N
PROGRAM ELEMENT TITLE: University Research Initiatives

Schedule: As applicable
Technical: As applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 1 PROGRAM ELEMENT: 0601103N Project Title: University Research Initiatives
PROGRAM ELEMENT TITLE: University Research Initiatives

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
University Research Initiatives	0	0	70,669	76,843	72,229	68,167	69,730	70,978

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The 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 program 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 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. The program provides the knowledge base, scientific concepts, and technological advances for the maintenance of naval power and national security.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Multidisciplinary University Research	0	0	55,658	55,827

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 2002 ACCOMPLISHMENTS:

- Not applicable. Efforts funded within RDT&E, Defense Wide University Research Initiative, PE 0601103D8Z.

FY 2003 PLANS:

- 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 02	FY 03	FY 04	FY 05
Defense University Research Instrumentation	0	0	13,901	19,906

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 2002 ACCOMPLISHMENTS:

- Not applicable. Efforts funded within RDT&E, Defense Wide University Research Initiative, PE 0601103D8Z.

FY 2003 PLANS:

- Not applicable. Efforts funded within RDT&E, Defense Wide University Research Initiative, PE 0601103D8Z.

FY 2004 PLANS:

- Conduct competition for approximately 80 research instrumentation awards to universities.

FY 2005 PLANS:

- Conduct competition for research instrumentation awards.

	FY 02	FY 03	FY 04	FY 05
Presidential Early Career Awards	0	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 2002 ACCOMPLISHMENTS:

- Not applicable. Efforts funded within RDT&E, Defense Wide University Research Initiative, PE 0601103D8Z..

FY 2003 PLANS:

- 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.

C. OTHER PROGRAM FUNDING SUMMARY: Not applicable.

NAVY RELATED RDT&E:
PE 0601153N Defense Research Sciences

NON-NAVY RELATED RDT&E:
PE 0601103A University Research Initiative (Army)
PE 0601103F University Research Initiative (Air Force)
PE 0601102A Defense Research Sciences (Army)
PE 0601102F Defense Research Sciences (Air Force)

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 1 PROGRAM ELEMENT: 0601103N Project Title: University Research Initiatives
PROGRAM ELEMENT TITLE: University Research Initiatives

D. ACQUISITION STRATEGY: Not applicable.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

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

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
In-House Laboratory Independent Research (ILIR)	16,095	15,992	17,400	17,745	18,064	18,404	18,481	18,843

MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program (a) sustains U.S. Naval Science and Technology (S&T) superiority, providing new technological concepts for the maintenance of naval power and national security, and helping to avoid scientific surprise while exploiting scientific breakthroughs and providing options for new Future Naval Capabilities; and (b) supports basic biomedical research at the Uniformed Services University for the Health Sciences (USUHS) by providing funding for military-specific medical research that is typically leveraged into over $30 million in new extramural funds each year. The Department of Navy (DON) component responds to S&T directions of the DON Integrated Warfare Architecture Requirements for long term Navy and Marine Corps improvements, is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command and the Marine Corps Combat Development Command, and enables technologies to significantly improve the Joint Chiefs of Staff's Future Joint Warfighting Capabilities. It is managed by the Chief Scientist of the Office of Naval Research (ONR) and executed by the Commanding Officers (COs) and Technical Directors (TDs) of the Naval Warfare Centers, and Naval Personnel Research, Bureau of Medicine and Surgery laboratories. The Uniformed Services University of the Health Sciences (USUHS) component is executed by the President of USUHS.

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

This portion of the DON Basic Research Program provides participating Navy Centers and Laboratories with funding for basic research to support the execution of their assigned missions, for developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to Naval problems, to promote hiring and development of new scientists, and to encourage collaboration with universities,

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

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

ILIR projects are selected by Center/Lab Contract Officers (CO) and Technical Directors (TD) near the start of each Fiscal Year through internal competition. Projects typically last 3 years, and are generally designed to assess the feasibility of new lines of research. Successful efforts attract external, competitively awarded funding. Because the Warfare Centers and Labs encompass the full range of naval technology interests, the scope of ILIR topics roughly parallels that of PE 0601153N, Defense Research Science. In FY02, about 50 projects were completed and 70 initiated.

Support for the basic medical research at the Uniformed Services University of the Health Sciences (USUHS) provides the only programmed research funds received by the University. In addition, it facilitates the recruitment and retention of faculty; supports unique research training for military medical students and resident fellows; and allows the University`s faculty researchers to collect pilot data in order to secure research funds from extramural sources (estimated $35 million annually). Eighty to 100 intramural research projects are active each year, including 20-25 new efforts. Projects are investigator-initiated and funded on a peer-reviewed, competitive basis. Results from these studies contribute to the fund of knowledge intended to enable technical approaches and investment strategies within Defense Science and Technology (S&T) programs. They are designed to answer fundamental questions of importance to the military medical mission of the Department of Defense in the areas of Combat Casualty Care (CCC), Infectious Diseases (ID), and Military Operational Medicine (MOM).

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

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

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical Not applicable

FY 2004/2005 RDT&E, N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

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

Project Title: IN-HOUSE LABORATORY INDEPENDENT RESEARCH

COST: (Dollars in Thousands)

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

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

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

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

FY 2002 ACCOMPLISHMENTS:

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

FY 2003 PLANS:

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

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

FY 2004 PLANS:

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

FY 2005 PLANS:

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

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

FY 2002 ACCOMPLISHMENTS:

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

FY 2003 PLANS:

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

FY 2004 PLANS:

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

FY 2005 PLANS:

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

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

FY 2002 ACCOMPLISHMENTS:

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

FY 2003 PLANS:

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

- Investigate newly derived asynchronous track fusion algorithms.

FY 2004 PLANS:

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

FY 2005 PLANS:

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

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

FY 2002 ACCOMPLISHMENTS:

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

FY 2003 PLANS:

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

FY 2004 PLANS:

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

FY 2005 PLANS:

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

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

FY 2002 ACCOMPLISHMENTS:

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

FY 2003 PLANS:

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

FY 2004 PLANS:

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

FY 2005 PLANS:

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

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

FY 2002 ACCOMPLISHMENTS:

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

FY 2003 PLANS:

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

FY 2004 PLANS:

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

FY 2005 PLANS:

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

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

FY 2002 ACCOMPLISHMENTS:

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

FY 2003 PLANS:

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

FY 2004 PLANS:

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

FY 2005 PLANS:

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

FY 2002 ACCOMPLISHMENTS: *Executed under 0601101D8Z.

FY 2003 PLANS: *Executed under 0601101D8Z.

FY 2004 PLANS:

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

FY 2005 PLANS:

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

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

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0601153N Defense Research Sciences

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

D. ACQUISITION STRATEGY: NOT APPLICABLE

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 1 PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: Defense Research Sciences

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Defense Research Sciences	378,742	396,330	368,517	377,223	390,861	398,708	405,649	412,930

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 directions of the Department of the Navy (DON) Integrated Warfare Architecture Requirements (IWARs) 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 JCS's Future Joint Warfighting Capabilities. It also is consistent with the DON Transformational Roadmap as articulated in SEA POWER 21. 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 12 Research Areas. These in turn support the major motivational research focus areas of the Navy and Marine Corps after Next: maritime and space environments that impact operational capability, information science/knowledge management in network-centric operations, sensors and electronic systems for surveillance and tactical applications, energy/power/propulsion for performance gain and sustainment, advanced air/surface/undersea and multi-environment Naval platforms design/signature reduction, and superior human performance/training/care of Sailors and Marines.

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

(starting FY99), Underwater Weaponry (started FY02), and Naval Engineering (starting in FY03) with an ongoing assessment of Precision Time and Time Transfer.

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

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	388,353	393,557	395,418	404,006
Adjustments from FY 2003 President's Budget:				
SBIR	-7,462			
Congressional Plus-Ups		+12,900		
Congressional Reduction		-1,000		
Cong. Rescissions/Adjustments/Undist. Reductions	-1,906	-4,848		
Execution Adjustments	-243			
NWCF Rate Adjustments			-1,876	-230
Efficiencies at NWCF Activities			-882	-1,007
S&T Program Adjustments			-14,935	-16,324
Pay Raise/Inflation Adjustments		-4,279	-9,208	-9,222
FY 2004/2005 President's Budget Submission:	378,742	396,330	368,517	377,223

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 1 PROGRAM ELEMENT: 0601153N Project Title: Defense Research Sciences
PROGRAM ELEMENT TITLE: Defense Research Sciences

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Defense Research Sciences	378,742	396,330	368,517	377,223	390,861	398,708	405,649	412,930

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project 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 directions of the Department of the Navy (DON) Integrated Warfare Architecture Requirements (IWARs) 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 JCS's Future Joint Warfighting Capabilities. It also is consistent with the DON Transformational Roadmap as articulated in SEA POWER 21. 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 12 Research Areas. These in turn support the major motivational research focus areas of the Navy and Marine Corps after Next: maritime and space environments that impact operational capability, information science/knowledge management in network-centric operations, sensors and electronic systems for surveillance and tactical applications, energy/power/propulsion for performance gain and sustainment, advanced air/surface/undersea and multi-environment Naval platforms design/signature reduction, and superior human performance/training/care of Sailors and Marines.

Key aspects of the project 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 (starting FY99), Underwater Weaponry (started FY02), and Naval Engineering (starting in FY03) with an ongoing assessment of Precision Time and Time Transfer.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Information Sciences	51,798	55,582	51,949	54,361

Efforts include: Autonomous systems; information assurance; information management and distribution; information processing, assessment, and presentation; seamless, robust connectivity and networking; modeling and simulation for planning, engineering and acquisition; theater air missile defense; and expeditionary operations Command, Control, Communications, Computers Intelligence Surveillance and Reconnaissance(C4ISR).

FY 2002 ACCOMPLISHMENTS:

- Developed techniques to enable a collaborating team of heterogeneous agents/robots to operate in unknown environments with uncertain sensing.
- Developed a fundamental basis for image recognition and understanding.
- Extended methods for detecting, removing, modifying, decrypting, and creating hidden messages in shared digital media.
- Developed methods to map large three dimensional urban areas with accurate geo-positioning in real time.
- Created science base for intelligent software agents that can reason about physical phenomena and communicate with human collaborators.
- Continued development of novel algorithms for energy-efficient broadcasting and multi-casting on wireless communication networks.
- Continued to investigate methods for employing automated systems as substitutes for human vision for monitoring surveillance and reconnaissance.
- Investigated time-reversal imaging with application to array imaging, secure wireless communications, and nondestructive testing.
- Investigated micro-fluids as detection and analysis of genetic materials used for chemical sensing.
- Continued work on image enhancement and feature extraction techniques for applications to target identification, strike and battle damage assessment.

FY 2003 PLAN:

- Develop theory and algorithms for autonomous systems to recognize a particular scene from different perspectives.
- Continue refinement of techniques for ensuring privacy of information transferred across public networks.
- Develop basis for collaborative mission planning tools to facilitate knowledge sharing and management, regulation of information flow, and work-process monitoring.
- Continue development of turbo-codes and iterative processing techniques to enable high data rates for wireless communication applications.
- Develop adaptive routing protocols to select the links for routing information packets that maximize communication network throughput with minimum energy consumption.
- Initiate 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.

FY 2004 PLAN:

- Complete theory and algorithms for autonomous systems to recognize a particular scene from different perspectives.
- Continue refinement of techniques for ensuring privacy of information transferred across public networks.
- Develop basis for collaborative mission planning tools to facilitate knowledge sharing and management, regulation of information flow, and work-process monitoring.
- Complete development of turbo-codes and iterative processing techniques to enable high data rates for wireless communication applications.
- Develop adaptive routing protocols to select the links for routing information packets that maximize communication network throughput with minimum energy consumption.
- 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.
- Initiate efforts on general automated theorem prover technologies and biometric technologies for authentication.
- Initiate efforts on modeling chaotic phenomena in network operations.
- Complete efforts in scaleable decision making algorithms for Command and Control.
- Complete efforts in natural language processing.
- Initiate efforts in multi-modal dialog.
- Initiate efforts for integrating domain knowledge into learning methods.
- Initiate computational statistics methods for data streams.
- Initiate efforts for semantic-based information gathering.
- Initiate efforts for multi-sensor 3D digital urban terrain reconstruction.
- Initiate efforts in extended augmented/virtual reality with haptics, sound, and olfactory components.
- Continue efforts in physics-based modeling of natural phenomena for visualization.
- Continue efforts in automatic inference of context from images/video.
- Initiate efforts in detection of caves and underground tunnels.
- 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.

FY 2005 PLAN:

- 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.
- Develop adaptive routing protocols to select the links for routing information packets that maximize communication network throughput with minimum energy consumption.
- Complete development of improved tactical and battlespace decision aids through creation of synthetic natural environments.
- Continue to refine techniques for extracting maximal knowledge from multi-modal imagery, text, and electromagnetic signal data.
- Complete 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, 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 prover 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 computational statistics methods for data streams.
- Continue efforts for semantic-based information gathering.
- Continue efforts for multi-sensor 3D digital urban terrain reconstruction and in physics-based modeling of natural phenomena for visualization.
- 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 detection of caves and underground tunnels.
- 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.

	FY 02	FY 03	FY 04	FY 05
Ocean/Space Sciences	142,598	140,949	140,322	143,543

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 2002 ACCOMPLISHMENTS:

- Developed an improved predictive capability of beach characteristics including berm heights and vehicle trafficability to enhance expeditionary force mobility through the surf-zone and across the beach.
- Continued to refine techniques for utilizing autonomous undersea vehicles to investigate coastal and ocean basin processes thereby increasing data collection in areas that are difficult to access.
- Continued study and characterization of solar coronal mass ejections to enable determination of space velocities and predict impacts on critical Naval and national space-based sensors and communication systems.
- Developed improved Earth upper atmospheric neutral density models for more accurate satellite drag prediction and improved estimates of useful satellite life.
- Employed the upgraded Polar Ice Prediction System for improved assessments of the wind-current dynamics of arctic ice movements to reduce the sea ice threat to military and civilian shipping.
- Continued investigation of the marine geology mechanisms for the formation of sedimentary flood deposits on continental shelves and the impacts those mechanisms have on sea mine burial and detection.
- Developed new techniques for extracting useful environmental information from existing observing systems in the most efficient and cost-effective way.

FY 2003 PLAN:

- Develop techniques for utilizing high resolution, motion imagery to predict beach evolution.
- Develop 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.

- Initiate 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.
- Develop improvements to specification and prediction of the space environment to improve space system performance and their on-call availability.
- Develop new techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography.
- Continue validation of environmental data and models used by S&T community to ensure reliability and realistic depiction of actual ocean and atmospheric conditions.
- Develop 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.
- Initiate an integrative ecosystem study to develop environmental predictors of whale presence or absence to reduce impacts of Naval systems to marine mammals.
- Develop new methods for combining "through the sensor" data with other views of the battlespace environment to improve real-time environmental predictions.
- Commence development of major ionospheric interactions research capability at the High Frequency Active Auroral Research Program (HAARP) to identify or improve C3I capabilities for Naval undersea warfare applications.

FY 2004 PLAN:

- 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/EO/IR sensors, and the performance of Naval weapon 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.

- 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.
- 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.
- Continue enhancement of ionospheric interactive research capabilities at HAARP and begin program of S&T development leading to improved performance of Naval undersea applications.

FY 2005 PLAN:

- 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 weapon 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.
- 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.
- 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 02	FY 03	FY 04	FY 05
Human Performance and Medical Sciences	21,700	21,831	22,540	22,954

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 2002 ACCOMPLISHMENTS:

- Developed theories and models that address re-configurable organizational structures to support command decision making and command and control team performance.
- Determined which brain areas are active in performing cognitive tasks and detect likely conflicts among multiple tasks due to loading of same brain areas.
- Advanced the understanding of the basis of stochastic chemical sensing.
- Completed complete genomic sequence of anthrax bacteria. Determined molecular structure of the marine photoprotein obelin at atomic resolution.
- Completed basic physiology research on hemorrhagic shock and trauma resuscitation to improve far-forward, life-saving casualty care.
- Investigated stress physiology to identify the biological bases of individual stress resilience and elucidate biological/cognitive events relevant to Naval operational exposures (e.g., hyperbaric stress, directed energy).
- Investigated genomics and genetic immunization to advance protection against microorganisms. Continued studies on stem cells and signal transduction for advanced transplantation strategies.

FY 2003 PLAN:

- Exploit improved understanding of human cognition and performance to create more realistic simulations and to improve decision algorithms.
- Develop computational linguistic techniques to emulate one-to-one tutoring behavior.
- Conduct research into the efficacy of a group of compounds that mimic or assist endogenous defenses to hearing damage to sailors and marines.
- Develop an understanding of the mechanistic basis of object detection and classification in biologic vision/audition and transform this understanding into robust algorithms for threat and situation assessment decision aids, automatic target recognition in cluttered environments, and detection and classification of buried mines.

- Develop new theoretical treatment of the differences in individual humans. Initiate program to study coiled-coil protein structures. Study self-assembled supramolecular nanoplatforms for molecular medical applications.
- Begin studies on microbial degradation of energetic compounds in marine sediments.
- 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.
- Initiate research effort on the physiological effects of exposure to non-lethal stimuli for a better understanding of human vulnerabilities and enhanced protection.

FY 2004 PLAN:

- Learn how to combine cognitive architectures with computational neuroscience to better predict human performance under stress.
- Initiate projects on antimicrobial peptides for inactivation of infectious bacteria.
- Launch efforts to develop next-generation antibiotics.
- Develop 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 PLAN:

- Develop novel multidisciplinary approaches to human-activity inference from video imagery to enable force protection and counterterrorism.
- Study methods to allow active vision for mobile robotics.
- Use genomics-driven metabolic pathway design for the synthesis of energetic materials.
- Initiate studies in aquatic environmental toxicology for diver protection.
- 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 02	FY 03	FY 04	FY 05

Advanced Naval Materials Sciences	67,008	72,883	69,120	71,697

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

FY 2002 ACCOMPLISHMENTS:

- Developed improved piezoelectric crystal growth techniques to revolutionize electromechanical transduction for sonar and undersea weapons applications.
- Developed an automated and cost effective process of liquid molding manufacturing of composite components for ship and aerospace applications.
- Continued work to improve understanding techniques for blast shock mitigation to ships/submarines. Developed novel luminescent quantum dot bio-conjugates for chemical and biological weapons sensor applications.
- Developed the science for thermally-stable, long living, highly efficient, light emitting diodes for use in maps and displays.
- Investigated the synthesis and assembly of nanoscale electro-active structures and composites for optical and thermal management applications.
- Continued investigation of engineering nano-structures into functional mesoscopic materials for advanced power sources, low cost technologies for display and transfer of information, and new methods for thermal management.
- Investigated corrosion fatigue cracking and stress corrosion resulting from employing friction stir welding construction techniques on type 2519 aluminum components of amphibious assault vehicles.
- Continued work to improve techniques for high power millimeter wave beam processing of ceramic materials.

FY 2003 PLANS:

- Explore three dimensional nature of solid phases in ferrous alloys for improved high strength steels.
- Design, synthesize and develop advanced polymers including high temperature and flame resistant polymer composites and ceramics for aerospace and ship applications.
- Continue 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.
- Develop understanding and procedures for growing controlled iron films with adlayer cappings of arsenic and gallium for spin injection structures and devices.
- Perform three dimensional microstructure analysis of high and low carbon steels to provide the scientific basis for fatigue and failure processes.

- Initiate work to develop the scientific basis for revolutionary approaches to discover advanced dielectrics for energy storage for eventual application in electric war ships.
- Establish the scientific basis for advanced materials with improved potential for blast resistance.
- Develop x-ray computed microtomography of composite materials using a synchrotron light source.
- Explore materials and structures capable of limiting optical transmission at variable wavelengths for enhanced eye and sensor protection against agile laser illumination.
- Develop novel magnetic materials for ship board high power applications.

FY 2004 PLANS:

- 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.
- Design and explore new processes for diphasic dielectric materials for energy storage for electric warship needs.
- Develop understanding and methodology to predict high deformation rate, blast, processes for engineered topological structures.
- 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.
- Explore the scientific basis for highly localized processes such as friction stir welding of steels for low cost ship construction.
- 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 theoretical basis for composite materials behavior based on x-ray computed micrco-tomography.

FY 2005 PLANS:

- 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.

- Explore superplasticity in advanced high strain nanometer scale ceramic composites to provide the basis for the development of such materials in naval applications.
- Explore molecular scale high energy storage dielectrics using solid state reactions to convert oxide layers to conductors for advanced capacitor applications.
- Develop materials and fabrication science for fugitive phase processes for engineered topological structures for ship blast protection.
- Continue to link ab initio calculations of structure to mesoscale simulations of alloy behavior for the design of advanced steels.
- Identify hydrogen embrittlement resistant high strength alloys based on nickel-cobalt-chrome-molybdenum material systems.
- 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.

	FY 02	FY 03	FY 04	FY 05
Naval Platform Design Sciences	16,931	17,363	15,508	15,876

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 2002 ACCOMPLISHMENTS:

- Developed new hull structural acoustic measurement methodologies to enable advanced machinery support systems and improved hull coatings.
- Conducted at-sea experiment on ship wave-breaking, revealing sources of bubble generation and migration.
- Incorporated a model of green water on deck into a motion prediction code for ships.
- Conducted an unprecedented experiment on a large hydrofoil and defined trailing edge hydrodynamics.
- Conducted visualization testing of propulsor tip vortices revealing major potential source of subvisual cavitation.
- Conducted studies of fast sealift configurations which defined technology advances required.
- Placed into operation an experimental apparatus for generating high levels of turbulence.

- Conducted the first quantitative spatial measurements of flow between turbomachinery blades revealing flow dynamics crucial to radiated noise sources.
- Identified unsteady propulsor blade loading due to upstream disturbances that have been found to be inviscid in nature and responsible for tip gap vortex unsteadiness.
- Developed hull structural assessments capabilities for determining the integrity of the ship throughout its service life. Identified and analyzed physics of stratified wakes.
- Identified active control and system stability criteria for very high (greater than 200MW) power systems.
- Identified and quantified bubble sources around surface ships including wave-breaking and turbulence effects.
- Developed new techniques for advanced sensors for emission monitoring, improved membranes for water waste treatment, anti-fouling/foul-release coatings knowledge base for fate/effects of metal and organic materials in the marine environment, and reduction or elimination of Chloro-Fluorocarbon-based cooling.
- Advanced current understanding of high level/nonlinear acoustic propagation and measurement of jet noise to enable passive and active noise reduction techniques. These efforts will result in reduced hearing loss by sailors and marines and reduced jet noise in areas where civilian population is closely adjacent to military facilities.

FY 2003 PLANS:

- Develop reliable sea-keeping prediction methods for advanced surface ship hull forms in heavy seas.
- Develop an integrated acoustics model for complex propulsors.
- Develop infrared ship predictions for low observable ships that include bi-directional reflectance distribution functions.
- Conduct quantitative measurements of bubble concentrations at-sea around a ship to develop prediction methods.
- Incorporate nonlinear incident wave representations in a ship motions prediction method.
- Conduct microbubble drag reduction experiments on a large plate.
- Construct and test a new instrument for spatial measurement of surface waves around models.
- Examine simulations of far wakes in a stratified medium evolution of vertical vortices.
- Measure and analyze high levels of turbulence interacting with blade flow for noise generation.
- Develop a method to infer, for the first time, fluctuating pressure in turbulent flow from Three Dimensional (3-D) Particle Image Velocimetry (PIV) measurements.
- Validate Six Degrees-Of-Freedom (6DOF) Reynolds Average Navier-Stokes (RANS) predictions of surface ship forced roll response.

- Develop a Large-Eddy Simulation (LES) prediction method for unsteady propulsor flow.
- Develop physics-based analysis tools and models for non-linear circuits and loads and highly coupled ship board power systems.
- Develop robust turbulence models in three dimension boundary layers to improve submarine maneuvering predictions.
- Continue work on understanding, predicting, and controlling scattering from discontinuities such as antennas and ship-sea surface radar cross section interactions.
- Develop next-generation infrared scene model to enable optimal infrared reflectance ship surfaces.
- Improve and extend 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.
- Investigate the fate and effects of chemical and biological contaminants in marine/estuarine environments.

FY 2004 PLANS:

- Continue development of reliable sea-keeping prediction methods for advanced surface ship hull forms in heavy seas.
- 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.
- Continue development of LES method for unsteady propulsor flow predictions.
- 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.
- Apply optimal stability criteria to electrical power systems in a simulation environment.
- 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.
- Initiate assessment of the fate and effects of chemical and biological contaminants in marine/estuarine environments.

FY 2005 PLANS:

- Continue development of reliable sea-keeping prediction methods for advanced surface ship hull forms in heavy seas.
- 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.
- Continue development of computational mechanics to provide predictive capabilities of acoustics, linear and nonlinear dynamic response and failure mechanisms of structures.
- Computational mechanics will also address prediction of acoustic signatures in complex structures, modeling of structural failures and optimization, sensitivity analysis and error control.
- 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.
- 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 electrical power systems in a simulation environment.

- 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.
- Continue assessment of the fate and effects of chemical and biological contaminants in marine/estuarine environments.

	FY 02	FY 03	FY 04	FY 05
Weapon and Energy Sciences	27,974	32,671	26,707	26,098

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

FY 2002 ACCOMPLISHMENTS:

- Developed first generation model to predict propellant burn rate as a function of pressure, fuel to oxidizer ratio, and relative oxidizer particle size.
- Developed computer codes to analyze and predict the two-phase flows around a supercavitating vehicle.
- Conducted water tunnel experiments to study the instability and control of a supercavitating vehicle.
- Conducted 4-inch model tests to quantify the flow noise of a supercavitating vehicle.
- Initiated a University Laboratory Initiative (ULI) program which establishes a strategic alliance between academia, Naval Laboratories and University Affiliated Research Laboratories with the goal of maintaining a constant infusion of educated and career minded scientists and engineers in support of the National Naval Responsibility (NNR) for undersea weapons research. The ULI program is developing a broad based technical personnel base in the disciplines of acoustics, information science, physics, mathematics, chemistry, electrical engineering and mechanical engineering.
- Developed dynamic loading/spectroscopic tools for combustion initiation processes.
- Investigated novel composites for lightweight long life rechargeable batteries.
- Investigated interactions between oxidizer and fuel in ammonium-per-chlorate based propellants.
- Continued study on pulse detonation engine dynamics and gaseous and spray detonations.
- Achieved significant progress in the development of fuel cell power sources that can operate on common logistic fuels for Marine combat units by demonstrating the direct oxidation of synthetic diesel in a solid oxide fuel cell.
- Investigated multi-axis fluidic thrust vectoring to enable elimination of missile fin structure and reduce heat and drag for hypersonic missile applications.
- Continued work to develop a compact, efficient, and automated vortex combustor for incineration of solid waste.
- Investigated techniques for developing deformable missile warheads to increase missile lethality by creating an asymmetric blast pattern focused in the desired direction.
- Developed a nanostructured solid block co-polymer electrolyte with performance comparable to liquid electrolytes at moderate discharge rates using a practical, scalable synthetic route with the goal of improving the safety and energy density of rechargeable lithium and lithium-ion batteries.

- Developed and experimentally validated a new model for solute transport in swollen polymeric gels to provide fundamental insight for polymer electrolyte development.
- Transitioned catalyzed carbon microfiber electrodes for semi-fuel cells to an unmanned undersea vehicle (UUV) demonstration program.
- Identified new class of solid state thermoelectric materials for solid state conversion devices.

FY 2003 PLANS:

- Continue to develop synthesis routes to difluoramino-based and organometallic-based highly energetic ingredients.
- Continue to develop spectroscopic capabilities to accurately determine aluminum combustion temperature in various oxidizing environments.
- Continue to develop fundamental understanding of nitramine and perchlorate decomposition mechanisms for propellant applications.
- Continue to develop fundamental understanding of initiation mechanisms of explosive crystals subjected to shock stimulus.
- Develop 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.
- Continue to refine the computer codes for two-phase flows, and investigate supercavitating vehicle dynamics and instability.
- Conduct additional 4-inch model tests to quantify the flow noise of a supercavitating vehicle.
- Expand the University Laboratory program to provide a further infusion of educated and career minded scientists and engineers in support of the NNR for undersea weapons research. This expansion will be conducted by increasing the collaboration with universities and Naval laboratories to broaden the education and technology base thereby seeding future non-traditional capabilities for undersea weapons.
- Develop mechanistic understanding of steady and unsteady combustion characteristics of advanced solid propellants. Develop nanoscale metalized explosives for enhanced lethality.
- Investigate interaction of combustion gases with engine nozzles at high temperatures and pressures to develop techniques for mitigation of nozzle erosion at high pressures.
- Synthesize and characterize new energetic materials with higher energy density and reduced sensitivity.
- Develop materials for enabling rechargeable batteries with an energy density approaching 500 watt-hours per kilogram.
- Continue investigation of combustion control techniques to enable improved thrust vector control, jet noise reduction, more efficient jet engines, and signature reduction.

- Conduct preliminary studies on multivalent ion insertion in nanoscale vanadium pentoxide cathode materials to improve the capacity of rechargeable lithium batteries.
- Continue improvements to catalyzed carbon microfiber electrode development for semi-fuel cells.
- Continue development of nanostructured electrode and polymer electrolyte materials for electrochemical power sources.
- Expand fundamental understanding of direct electrochemical oxidation in solid oxide fuel cells and the use of logistic fuels.
- Expand research into new materials and processes for converting thermal to electric energy.
- Identify new approaches to efficiently transfer thermal, electrical and optical energy from primary sources.
- Develop new energy efficient sources and devices to enable future electric Naval Force.
- Initiate research in materials and processes for energy efficiency.

FY 2004 PLANS:

- Continue to develop synthesis routes to difluoramino-based and organometallic-based highly energetic ingredients.
- Continue to develop spectroscopic capabilities to accurately determine aluminum combustion temperature in various oxidizing environments.
- Continue to develop fundamental understanding of nitramine and perchlorate decomposition mechanisms for propellant applications.
- Continue to develop fundamental understanding of initiation mechanisms of explosive crystals subjected to shock stimulus.
- Continue to develop 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.
- Continue computer code refinements and investigation of supercavitating vehicle dynamics and instability.
- Conduct 4-inch free-running model tests to evaluate control concepts and devices for a supercavitating vehicle.
- Continue the University Laboratory Initiative program to provide an infusion of educated and career minded scientists and engineers in support of the NNR for undersea weapons research.
- Continue research into alternative binder materials for explosives and propellants which are compatible with higher energy ingredients.
- Continue research into the fundamental mechanisms of explosive sensitization/detonation.

- Continue research in man-portable electrical energy storage and conversion.
- Continue improvements to catalyzed carbon microfiber electrode development for semi-fuel cells.
- Continue development of nanostructured electrode and polymer electrolyte materials for electrochemical power sources.
- 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.
- Continue work in science related to direct energy conversion.
- Enhance research on energy transfer science and research into materials and processes for energy efficiency.
- Enhance activities in nanoscience based approaches to novel power sources.

FY 2005 PLANS:

- Continue to develop synthesis routes to organometallic-based highly energetic ingredients.
- Continue to develop spectroscopic capabilities to accurately determine aluminum combustion temperature in various oxidizing environments.
- Continue to develop fundamental understanding of nitramine and perchlorate decomposition mechanisms for propellant applications.
- Continue to develop fundamental understanding of initiation mechanisms of explosive crystals subjected to shock stimulus.
- Continue to develop 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.
- Conduct 4-inch free-running model tests with homing sensors and control devices on a supercavitating vehicle.
- Continue the University Laboratory Initiative program to provide an infusion of educated and career minded scientists and engineers in support of the NNR for undersea weapons research.
- Continue research into alternative binder materials for explosives and propellants which are compatible with higher energy ingredients.
- Continue research into the fundamental mechanisms of explosive sensitization/detonation.
- Continue research in man-portable electrical energy storage and conversion.
- Continue development of nanostructured electrode and polymer electrolyte materials for electrochemical power sources.
- Identify and focus on most promising energy conversion science concepts.
- Continue efforts in novel power source development.

- Initiate studies of integrated science approaches to energy efficient electric Navy.

	FY 02	FY 03	FY 04	FY 05
Electronics/Sensor Sciences	45,448	42,439	42,371	42,694

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.

FY 2002 ACCOMPLISHMENTS:

- Developed methods for utilizing Raleigh waves for detection of land mines in various realistic soil types.
- Identified basic principles and techniques to allow precise control over atomic and molecular quantum states and enable more stable and precise atomic clocks for navigation and guidance. Such control also led to designs for more sensitive gyros and gravity gradiometers for inertial navigation and tunnel/bunker detection.
- Characterized the effects on performance of target echoes and boundary and volume scattering for shallow water active sensors.
- Quantified electromagnetic characteristics in the littoral environment to support mine countermeasures and surveillance systems.
- Developed autonomous undersea vehicle compatible sensors that can provide two and three-dimensional images for small target recognition.
- Developed techniques for extending the average power of solid state lasers by eliminating the heating of the laser medium.
- Continued to improve radio frequency and electronic warfare emission and reception by using wide bandwidth optical fiber signal processing techniques.
- Developed a set of advanced digital signal processing algorithms that support Naval information extraction requirements and throughput capabilities of emerging digital receiver technologies.

FY 2003 PLANS:

- Develop high voltage gradient particle linear accelerators by using Wakefield acceleration techniques.
- Explore concepts for new compact tunable short wavelength radiation sources.
- Develop novel large area plasma processing system for high density plasma etching for microelectronics applications.

- Continue development of physics-based, broadband, bi-static active classification algorithms to achieve low false alarm rates.
- Extend development of a hybrid millimeter wave/infrared lens to a 2-color capability for use in advance focal plane arrays.
- Continue development of radio frequency scattering models to more effectively account for composite structures and coated surfaces.
- Establish proof-of-principle of a new aircraft defense capability involving acquisition and laser countermeasure against threat missile seekers prior to their launch.
- Continue to collect and analyze millimeter wave radar time-series data on ships, decoys, and low grazing angle sea clutter and identify potential countermeasure techniques and incorporate millimeter wave phenomena into high fidelity models.
- Continue development of improved clocks, gyros and gravity gradiometers through atom interferometry, quantum information approaches, and optical meteorology. Self- and directed-assembly techniques will be explored as a means to fabricate molecular, nanomagnetic and nanoelectronic components.

FY 2004 PLANS:

- Investigate optical frequency standards and optical clocks based on optical frequency combs to span the frequency scales, and either ion traps, optical lattices, or atom fountains to isolate and interrogate the atoms.
- Investigate further atom-interferometric gyros to seek orders of magnitude gain in sensitivity. Gravity gradiometers will be further explored and improved in sensitivity.
- Explore atom optical devices.
- Develop new sources and detectors of quantum optics in the IR spectrum, and seek to exploit quantum information theoretic concepts to reduce noise.
- Support the Navy/DARPA wide band gap initiatives.
- Research bulk nitride semiconductor substrates (none are currently available), extended and point defect (deep level) identification characterization and elimination, by (amongst others) 'halide-assisted' epitaxy and bulk SiC crystal growth and semi-insulating substrates and epitaxial Nitride and SiC films.
- Research epitaxial multifunction crystal growth on wide gap semiconductors for increased monolithic integration/performance capability (tunable dielectrics, sensors, magnetic materials for Spin devices, superconductors, and non linear optical structures).
- Explore power tunnel junctions/diodes for improved pin-pn stacking and contacts, micro/millimeter wave power bipolar transistor materials and device technology.

- Research SiC materials and devices for power conditioning technology in the "All Electric Ship". Explore metalization/contact technology for both p- and n-type films as well as Schottky barriers and dry processing (etching, passivation, etc).
- Construct molecular and nanometer-scale electronic and magneto-electronic devices and sensors using assembly-based nanocomponents.

FY 2005 PLANS:

- Continue to investigate and propose designs of optical frequency standards and optical clocks based on optical frequency combs to span the frequency scales, and either ion traps, optical lattices, or atom fountains to isolate and interrogate the atoms.
- Design on-chip atom-interferometric gyros for miniaturization and orders of magnitude gain in sensitivity over designs of that size.
- Further explore and improve in sensitivity gravity gradiometers.
- Take research into atom optical devices into design stages. Quantum optics ideas will enable lower noise sources and detectors.
- Continue supporting the Navy/DARPA wide gap initiatives in the areas of: bulk nitride semiconductor substrates; extended and point defect (deep level) identification characterization and elimination, by (amongst others) 'halide-assisted' epitaxy and bulk SiC crystal growth; semi-insulating substrates and epitaxial nitride and SiC films.
- Continue research in epitaxial multifunction crystal growth on wide gap semiconductors for increased monolithic integration/performance capability (tunable dielectrics, sensors, magnetic materials for Spin devices, superconductors, and non linear optical structures).
- Explore Power tunnel junctions/diodes for improved pin-pn stacking and contacts, micro/millimeter wave power bipolar transistor materials and device technology.
- Research SiC materials and devices for power conditioning technology for the "All Electric Ship".
- Explore metalization/contact technology for both p- and n-type films as well as Schottky barriers and dry processing (etching, passivation, etc), as well as other technologies to support wide band gap initiatives.
- Construct nanoelectronic circuits using assembly techniques in combination with conventional lithography.
- Explore fault-tolerant circuit architectures that can function in spite of imperfect assembly.

Congressional Plus-Ups:

	FY 02	FY 03
Marine Mammal Low Frequency Sound Research	961	N/A

Environmental concerns covering the impact the effects of sonar on underwater mammals have risen to significant levels in recent years.

FY2002 Accomplishments

- Conducted Navy research on the possible effects of man-made underwater noise on protected marine life. Included work associated with the University of Hawaii Marine Mammal Facility and related programs in the state of Hawaii. These programs are unique in providing species of marine mammals (Risso's dolphin, false killer whale) not found elsewhere, and in providing the unique coral reef sheltered, warm, clear waters needed for certain experiments involving open water work with trained research marine mammals.

	FY 02	FY 03
Quantum Optics Research	481	4,791

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.

FY2002 Accomplishments

- Conducted basic research to investigate the feasibility of developing quantum optics technologies for sources and detectors in Naval applications.

FY2003 Plans:

- Continue 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 02	FY 03
Southeast Atlantic Coastal Ocean Observing System	3,843	*

- $5,478 (Appropriated in FY03 in 0602435N)

Understanding the impact of the changing environment on the worlds oceans and predicting future trends so that we can better deal with man's affects on the ocean is vital to the future of our country and the world. Setting up an ocean observing systems advances this understanding by collecting, documenting and making available the data to the broader oceanographic community.

FY2002 Accomplishments

- Developed a four-state, inter-institutional partnership that would develop a regional coastal ocean observing system designed to measure conditions in and above the coastal ocean and to report these observations to a broad user base. The system covers the region between the Virginia/North Carolina border to the Dry Tortugas. The effort was conducted under the auspices of the National Ocean Partnership Program.

	FY 02	FY 03
Consortium for Military Personnel Research	N/A	1,368

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.

FY2003 Plans

- Efforts in military personnel research that advance the Navy's ongoing efforts in the areas of retention, accession, selection, classification, distribution, assignment, personnel policy and training management.

	FY 02	FY 03
Naval Basic Research	N/A	4,986

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.

FY2003 Plans

- Investigate the solar spectrum and its effects on military systems.
- Conduct modeling of cell-based biosensor arrays in an effort to assist in the rapid detection and identification of potentially toxic substances. Pursue research that will lead to the design of complex biomimetics architectures.

	FY 02	FY 03
Robotic Countermine Technologies	N/A	1,467

Mine countermeasures in shallow water and particularly, the surf zone is 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.

FY2003 Plans

- Develop and produce an undersea robotic platform based on biologically derived engineering concepts.

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 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602114N
PROGRAM ELEMENT TITLE: Power Projection Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Power Projection Applied Research	86,004	105,324	114,144	107,260	83,870	76,443	57,931	59,051

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 Program Element (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.

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

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602114N
PROGRAM ELEMENT TITLE: Power Projection Applied Research

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	83,413	76,612	63,221	61,206
Adjustments from FY 2003 President's Budget:				
Congressional Plus-Ups		31,075		
Cong. Rescissions/Adjustments/Undist. Reductions	-406	-1,220		
SBIR Reduction	-1,002			
S&T Program Adjustments		-1,143	54,141	48,784
NWCF Rate Adjustment			-222	-42
Execution Adjustments	3,999			
Efficiencies at NWCF Activities			-362	-375
Pay Raise/Inflation Adjustments			-2,634	-2,313
FY 2004/2005 President's Budget Submission:	86,004	105,324	114,144	107,260

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

Budget Activity: 2
PROGRAM ELEMENT: 0602114N Project Title: Power Projection
PROGRAM ELEMENT TITLE: Power Projection Applied Research Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Power Projection Applied Research	86,004	105,324	114,144	107,260	83,870	76,443	57,931	59,051

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. In particular the technology developed in this project 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 project 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.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

Fleet Defense & Air Dominance	FY 02	FY 03	FY 04	FY 05
	8,312	10,037	5,575	3,045

The focus of this effort is on those technologies that will support defense of the fleet in the littoral area and to provide for air dominance in all of the operating areas that Naval forces will operate in the future. Technology areas include: advanced Air-to-Air (A-A) missile seeker and propulsion technologies, Infrared focal plane arrays (IRFPA) and hyperspectral algorithms for target detection, laser tracker and identification, automatic target recognition (ATR) for air targets, High Energy Lasers (HEL) and Directed Energy weapons, advanced warhead and fuzes for use against high speed maneuvering threats, Radio Frequency (RF) photonics to increase bandwidth and reduce size/weight of phased array detectors, radar detection technology in clutter, and advanced Counter-Counter Measure (CCM) techniques for improved missile performance.

FY 2002 ACCOMPLISHMENTS:

- The Long Wave Infrared (LWIR) task goal is to develop low loss, high strength fibers (8-12um) required for the Navy's threat warning system and infrared countermeasures. The LWIR fiber task produced fibers at 75 kpsi strength and multifiber coherent bundles up to 3m in length.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

Budget Activity: 2

PROGRAM ELEMENT: 0602114N Project Title: Power Projection
PROGRAM ELEMENT TITLE: Power Projection Applied Research Applied Research

- The purpose of the Multispectral Infrared Focal Plane Array (IRFPA) effort is to develop advanced infrared detectors and focal plane arrays that will improve sensitivity, operating range, field of view (FOV), and counter measure hardness in Forward Looking Infrared Receivers (FLIR), missile seeker, missile warning and surveillance sensors. The IRFPA task demonstrated improved color detector materials, an improved long wavelength detector, and laser hardening approaches for uncooled detectors.
- The Electro Optic/Infrared (EO/IR) effort developed sensors, nanotechnology-based gyroscope/accelerometer sensor stabilization mechanisms to provide more accurate targeting, and identification of potential targets. The hyperspectral algorithm effort evaluated and improved the algorithm packages for a family of hyperspectral sensors to improve detection and identification of targets in camouflage and complex environments. The Laser tracker and identification Automatic Target Recognition (ATR) effort provides the ability to detect track and identify air targets. The task developed an approach that uses laser vibrometry to classify/identify threats. This effort flew a stabilized, eye safe laser on a gimbal to measure sensor and platform vibration. The purpose is to determine the impact of vibration and atmospheric turbulence on laser beam divergence and coherence. Completed work on Laser interrogator tracker. It will transition to the Fleet/Force Protection FNC to provide the DDX with fire control quality information on all target types, including the asymmetric threat.
- The Air-to-air weapons effort completed this year. The Aim Airframe control task fabricated and assessed an advanced high temperature missile section. The Surface Wave Antenna Guidance (SWAG) effort conducted field test and evaluation to evaluate the performance of the SWAG seeker in potential air-to-air environments. The Short Pulse Laser Target Detection Device (TDD) task completed demonstrations against targets in fog and clutter. A systems assessment for weapon needs addressing asymmetric threats was conducted. A systems assessment of high performance, solid state Radio Frequency (RF) seeker technology that is appropriate for the advanced cruise missile defense problem was initiated. The Reactive Material Warhead Target Interaction Lethality Vulnerability (TILV) effort continued.
- The High Energy Laser (HEL) weapons development effort initiated the fabrication of test equipment to be used for propagation measurements of beam coherence in aerosol rich environments. Analyzed existing climatology data for aerosol microphysical and meteorological properties in maritime and coastal environments. Develop multi-year climatologies and probabilities of severe propagation impacts in sensitive marine/coastal regions. A field test was conducted in a sensitive region of the world to provide a short term, detailed characterization of the vertical distribution of aerosols.
- The High Performance Turbine Engine Technology (IHPRPT) program demonstrated an air launched rocket with a high-pressure nozzle and composite motor case. The air-to-air project demonstrated a flight weight, high pressure; highly loaded, full scale air-to-air motor incorporating an end-burner motor with reduced smoke propellant, advanced composite case (T-1000 & Ultra High Modulus (UHM) fibers), dual movable nozzle, and thrust vector control (TVC). The gun launched motor project demonstrated in flight a high pressure, highly loaded, full scale, gun launched munition motor incorporating an end-burner motor with aluminized propellant, and advanced composite case (aluminum metal matrix) technologies. The surface launched effort conducted full scale testing of a 40 to 1 turndown ratio pintel motor with aluminized boost propellant.

FY 2003 PLANS:

- The LWIR fiber development will produce 8-12 um fiber at greater than 100 kpsi strength and 1 micron core material in lengths greater than 1 km.
- The Multispectral IRFPA will demonstrate color techniques for air to surface targeting and transition IRFPA hardening techniques to industry.
- The gyro stabilization portion of the EO/IR effort will fabricate and test the gyroscope, accelerometer, and inertial measurement unit designs. The hyperspectral task will demonstrate the algorithm packages in operational exercises. The ATR effort will upgrade a high coherence eye safe laser and demonstrate laser vibrometry ATR of airborne platforms and target discrimination (threat vice non-threat). Demonstrate extended range laser tracker and identification of air targets.
- Conduct subsystem concept definition trade studies of the weapon control, launcher, weapon guidance and control, and warheads for the asymmetric threat defense effort. Development of high performance solid state RF seeker technology for defeat of advanced anti-ship cruise missiles will continue. A study of technology requirements to enable hit-to-kill missile defense against anti-ship cruise missiles will be performed. The Reactive Material TILV effort will conclude. The HEL weapons development effort will continue to make detailed propagation measurements to evaluate the performance of the HEL when conducting shipboard operations in the ocean/littoral environment.
- The Advanced Reactive Material effort will continue development of advanced Reactive Material compositions. Reactive Materials are warhead material formulations that result in warhead fragments that combine both kinetic and chemical energy. This combination of kinetic and chemical energy produces structural kills rather than the component kills that inert fragments generate.
- The IHPRPT program will be terminated at the end of FY03. The FY03 efforts will include full scale testing of an aluminized boost propellant. Concept evaluation will conclude for the advanced Thrust Vector Control (TVC) concepts incorporating pitch, yaw, and roll control along with thrust magnitude control capability. Propellant ingredient and formulation investigations will be completed for advanced reduced smoke propellant for air-launched applications.

FY 2004 PLANS:

- The Advanced Imaging Seeker Countermeasure effort will develop imaging infrared countermeasures (IRCM) against imaging missiles using a unique state of the art hybrid approach. The FY04 work will implement preprocessing and track algorithms into imaging surrogates. The Millimeter Wave (MMW) threat detection technology effort will develop preliminary hardware and software designs for channelized and photonic Ka/W band Electronic Warfare (EW) receiver designs.

- Develop high-performance, low-cost EO/IR airborne surveillance sensors for unmanned aerial vehicles. Develop ultra-high performance EO/IR Imagers. Develop auto-target identification techniques for Laser Range-gated imagers.
- Perform subsystem design studies for the asymmetric threat defense effort. Identify key subsystem technology challenges and develop subsystem level demonstration goals.

FY 2005 PLANS:

- The Advanced Imaging Seeker Countermeasure effort in 05 will develop new generic cooperative imaging IRCM techniques and verify and refine existing concepts. The MMW threat detection technology task will fabricate channelized and photonic prototype receivers.
- Fabricate components and integrate subsystems for the asymmetric threat defense effort.

	FY 02	FY 03	FY 04	FY 05
Free Electron Laser (FEL)	1,508	4,380	10,000	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 the FEL can be successfully scaled up to weapons level power it could be considered for shipboard applications as a defense weapon against advanced cruise missiles and asymmetric threats.

FY 2002 ACCOMPLISHMENTS

- Initiated commissioning of the 10 kW Free Electron Laser (FEL).

FY2003 PLANS:

- Develop an optical klystron to extend the FEL performance into the Infrared (IR) bands. Complete commissioning and demonstrate a 10 kW FEL.

FY 2004 PLANS:

- Conduct beam quality experiments at the 10 kW level. Conduct design and cost studies evaluating multiple design alternatives for development, fabrication, and demonstration of a 100 kW FEL.

FY 2005 PLANS:

- Initiate detailed design and component fabrication for the 100 kW demonstration FEL.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

Budget Activity: 2

PROGRAM ELEMENT: 0602114N Project Title: Power Projection
PROGRAM ELEMENT TITLE: Power Projection Applied Research Applied Research

	FY 02	FY 03	FY 04	FY 05
Naval Precision Strike Operations	35,575	33,973	69,000	64,200

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. Some of the technologies employed to support the Navy strike capability include: Unmanned Air Vehicles (UAV) to locate, identify, and target critical enemy resources and weapons, rapid targeting technologies to enable rapid employment of long range precision strike weapons, smart/high speed weapons to support the attack of time critical targets, and improved explosives with energetic capabilities that will inflict greater damage against the target. This area also includes advanced navigation Science and Technology which is developing technologies in the areas of precision clock and time distribution, Precision Terrain Aided Navigation (PTAN), Laser light sources for fiber optic gyros (FOG), and Relative Navigation.

FY 2002 ACCOMPLISHMENTS:

- The purpose of the Autonomous Operations (AO) UAV task is to develop software to detect threats, collision situations and targets of opportunity with operator, and pre-programmed reaction. Developed secure jam resistant communications links and architecture for networking and multi-vehicle operations. Developed command, control and information display for multiple UAVs conducting simultaneous imaging missions using a single UAV operator. Developed software technologies that permit single frequency multi-point communications between multiple UAVs and their ground station.
- Initiated the UAV Radar effort with the goal of developing a radar concept and signal processing algorithms for the Navy's planned Tactical Ultra Light UAVs. This will provide the Navy with the ability to safely detect and direct weapons against over-the-horizon, slow moving, ground targets. Obtained and assembled components, and integrated and tested the UAV radar system and instrumentation hardware.
- The Micro Air Vehicles (MAV) program demonstrated autonomous flight, conducted mission demonstrations and integrated payloads and sensors/autopilots with MAV. The applied research portion of this program will transition to next-generation advanced single vehicle and distributed multiple-vehicle programs.
- Successfully completed the Distributed Time Standards (DTS) effort to develop a program to average various clock values in order to maintain system time as accurately as possible with respect to Universal Coordinated Time (UCT). The software developed will transition to the Navy Navigation Sensor System Interface (NAVSSI). The relative navigation task for Global Positioning System (GPS) and Link 16 to develop greater positional fix accuracy has identified the limits of time-code transmission accuracy. This effort completed a Kahlman filter software design for the NAVSSI. The High Precision Light source for the FOG of Inertial Navigation Systems (INS) task identified the laser parameters that will reduce system noise and developed an Engineering Development Model (EDM) of a laser light source to be included in the FOG. The Network Centric Navigation task was initiated. This effort exploits the wide bandwidth and low latency of proposed Department of Defense (DoD) communication networks to enable the new networks to carry extremely accurate position and precision time

information along with the communications info normally carried. Initiated a task to conduct a threat analysis of GPS and other navigational devices such as Micro-Electronic Mechanical Systems (MEMS) and Inertial Measurement Units (IMU). This effort began with identifying the vulnerabilities of the components.

- The Weapons Imagery Link (WIL) program is a Radio Frequency (RF) communications link, which will provide data bandwidth for the transport of moving imagery (video) and weapon control data for standoff weapons such as Standoff Land Attack Missile-Expanded Response (SLAM-ER). Conducted a test of a dynamic network using a complex array of terminals, a simulated weapons delivery under multiple scenarios, and a video relay through two terminals and a long distance video relay. This effort will transition to PE0603114N in FY03.
- The Mission Responsive Ordnance (MRO) effort performed Small Scale Penetrator Tests to quantify various design constraints against depth in concrete. Down selected to two structural concepts and two safe arm architectures. Selected baseline warhead size.
- The Hypersonic Weapons Development completed Leading Edge airframe component testing and test data analysis. The seeker window/dome task prototyped window/airframe integration. The air breathing hypersonic propulsion task integrated flow control algorithms and actuators into test hardware and demonstrated the ability to control combustion. Direct connect measurements of the Dual Combustion Ramjet (DCR) were completed and free jet tests performed.
- The Technology for the Sustainment of Strategic Systems (TSSS) program continued to upgrade Radiation Hardened (RAD HARD) models, codes and databases. The Solid Rocket Motor (SRM) effort produced structural and gas dynamic coupled models. The drag reduction device task finalized the database, identified Computational Fluid Dynamics (CFD) tool candidates, and identified the static stability method.
- The Weapons program Supersonic Airframe control effort selected and fabricated the control concept for the strike weapon, and investigated the extendibility of the concept into the hypersonic speed regime. The Configurable Automatic Target Recognition (CATR) effort defined the tasks necessary for the ATR Laser Radar (LADAR) identification of targets and evaluated reconfigurable architectures for the CATR system. The MEMS antenna task completed the fabrication of the demonstration seeker and investigated the applicability of MEMS in high power RF seeker applications.

FY 2003 PLANS:

- The UAV advanced technology task will develop single frequency, multi-UAV imaging ops capability using only the secondary UHF data link. Develop command, control and information display for multiple UAVs conducting simultaneous imaging missions using only a single UAV operator.
- Conduct field and lab tests of UAV radar system.
- Complete the relative Navigation task for GPS and Link 16. FY03 work will involve developing plans to implement the systems on Navy ships. Complete the High precision light source FOG task by developing the alternative laser design of the FOG system. The Network Centric Navigation task continues with the work of determining the latency of representative networks in the trial or planning stages of those networks. The GPS

and Navigation device task will also continue with the identification of specific GPS failure modalities and determine the potential for foreign forces and terrorist groups to exploit those vulnerabilities. The results will be factored into the Digital Signal Processing design and the development of a RF design to reduce front end vulnerabilities. New areas will be initiated in FY03 that will exploit the benefits of more current ephemeris data and of the existing phase coherence between CA, P(Y), and M-code signals. Also added are efforts to deliver more seamless and consistently precise time in a network context. This work involves the development of algorithms and hardware that can assess the quality of an ensemble of inputted clock data.

- The MRO effort will perform mid-scale penetration tests to validate survivability of structure. Demonstrate dispenser component functionality. Perform static arena tests of warhead against various targets.
- The TSSS program will involve upgrading and linking RAD HARD codes and evaluating the software. The SRM effort will perform code validation with legacy models and preliminary verification on new models. The drag reduction device task will develop a first order CFD model, complete the CFD model test trials, and integrate static stability models.
- The Ordnance Systems for High speed penetration work will develop advanced fuze, warhead and structural components that can be integrated into high speed strike weapons which are used to attack high value, deeply buried targets.
- The Advanced Reactive Weapons Task for Hard and Deeply Buried Targets (HDBT) will develop and examine alternate methods of production for advanced energetic materials that increase structural strength and performance, when compared to current state of the art materials, while maintaining high levels of exothermic energy in the forms of shock waves and high gas overpressures when initiated. These advanced reactive material structures appear to indicate that using filled lattice geometries provides higher structural strengths and produces superior lethality for penetration weapons than current explosive formulations.
- The HyFly National Aerospace Initiative effort will design and develop flight weight hardware that can be integrated into a hypersonic strike vehicle. The program will develop a lightweight Dual Combustion Ramjet (DCR) concept vehicle for the airframe integration task. The advanced air-breathing propulsion task will develop a full-scale test device and demonstrate full-scale combustion control. The supersonic inlet task will begin evaluation of inlet concepts and the preliminary inlet design.
- The Weapons program Supersonic Airframe control task will design for a ground test to demonstrate a section level integrated control concept extendable into the hypersonic speed regime. The Configurable ATR work, which has integrated a family of tunable algorithms, will continue with the development of a process oversight manager that will provide for the tuning of the ATR algorithms. The MEMS antenna task will evaluate the fabricated seeker and then begin development of the high power RF seeker. Initiate the development of moving target and ATR algorithms. An effort will be initiated to advance the technologies needed to further automate the management and control of several retargetable weapons and unmanned vehicles providing Intelligence, Surveillance and Reconnaissance (ISR)/targeting functions. Conduct subsystem concept definition trade studies of the weapon control, launcher, weapon guidance and control, and warheads for the asymmetric threat defense effort.

FY 2004 PLANS:

- The AO UAV technology task will complete development and perform simulation testing of software to detect threats, collision situations and targets of opportunity with operator, and pre-programmed reaction. Continue development of secure jam resistant communications links and architecture for networking and multi-vehicle operations. Continue development of command, control and information display for multiple UAVs conducting simultaneous imaging missions using a single UAV operator. Continue development of software technologies that permit single frequency multi-point communications between multiple UAVs and their ground station.
- Complete the UAV radar program by performing airborne testing using a Piper Aztec as a surrogate platform.
- GPS-Continue the Network Centric Navigation task by assessing the time synchronization and precision time transfer using the Naval Research Laboratory (NRL) Distributed Time Standards and Space and Naval Warfare Systems Command (SPAWAR) system center test beds. The GPS and Navigation Device threat analysis will review the proposed methods of eliminating the vulnerabilities and select the most promising approaches.
- The Naval Unmanned Combat Air Vehicle (UCAV-N) effort will continue operational concept development and analysis, design of combat subsystem components, and continue the design and development of Mission Control System (MCS) software.
- Increase program emphasis in Network-Centric areas in order to enable and widely distribute more accurate and precise data that will lead to rapid target location and rapid target-threat elimination. Work will focus on increased emphasis in GPS/INS. Continue GPS ephemeris updates, triad GPS signal coherence, KAS-1 update, GPS/INS refinement, Controlled Radiation Pattern Antenna (CRPA) isolation improvements.
- The MRO will conduct a Demonstration of multi-point timing showing that critical target data fusion can be accomplished. Initiation tests on the distributed safe and arming device for the munitions package will be conducted, leading to full scale demonstration test hardware being completed.
- Begin HyFly air vehicle and fuel system testing. Validate operational flight program software using hardware in-the-loop testing. Conduct interface testing between flight test vehicle and carry aircraft. Fully transitions to Power Projection Advanced Technology (Budget Activity 3) in FY 2005.
- In the TSSS effort, the RAD HARD System Design Tool task will continue efforts in upgrading and linking validated Commercial off the Shelf (COTS) RAD HARD codes with more emphasis software validation and verification in different platforms. The SRM ignition response effort will perform advanced nonlinear model comparisons with ground test data. The Drag Reduction Devices task will, by application of COTS, develop an advanced aerospike drag reduction model and verify and validate with ground test data. The advanced model will be integrated into a trajectory simulation via a simpler model adapted to trajectory simulation. Static stability models will be generated to complete the required models for a trajectory simulation of missiles with drag reduction devices. For the accelerometer task, two Proof of Concept, Superconducting and Atom Interferometer, Gravity Gradient Sensors fabricated and a Proof of Concept new technology accelerometer for

Fiber Optic Gyro-Navigation (FOGN) use designed. Plan to complete build 1 of the Electronic Design Advisor (EDA), complete load of documents and data into the Electronic Interactive Database (EID), and publish the beta version of the Integrated Underwater Launch (UWL) Technology System.

- The Strategic Systems Infrastructure (SSI) effort will consist of 5 tasks. Missile propulsion technology task will increase performance and reduce costs on solid rocket motor systems. The advanced Post Boost Control System (PBCS) will develop advanced variable thrust Post Boost system technologies. The Ordnance system task will develop replacement technology for Exploding Bridgewire (EBW) detonator systems. The Missile Electronics task will develop a capability to model the electrical behavior of components in strategic missile environments. The Navigation Sonar Task will develop advanced technology acoustic sensors for Navigation Sonar Systems (NSS). The FY04 Missile propulsion effort will formulate high performance propellants and conduct subscale static motor tests of composite materials and begin subscale chamber design and hydroburst tests. The Advanced PBCS effort will develop a preliminary design and conduct parametric testing. The ordnance initiation task will develop a preliminary design, conduct subscale tests, and perform theoretical bus dynamics analysis. The Missile electronics task will evaluate test data of the effects of the external environment on the operation and reliability of missile electronics. The effort will then begin the development of models to predict and track those effects. The Navigation Sonar task will transition ONR's advanced transducer and design and develop a new hydrophone array.
- The Supersonic Cruise Missile (SSCM) National Aerospace Initiative (NAI) technology base program supports the development of high speed (supersonic to hypersonic) turbine and airframe technologies for expendable weapons applications. Component areas include inlets, compression, combustion, turbine, controls, exhaust nozzles, airframe materials and controls. Turbine engine component designs will be initiated that will increase the performance of components such as a high temperature lightweight compressor, a high fuel air ratio combustor, and a reduced length shear layer mixed augmentor. Cost reduction efforts will focus on a reduced parts count turbine, and an advanced exhaust nozzle.

FY 2005 PLANS:

- The AO UAV technology task will analyze simulation test of software to detect threats, collision situations and targets of opportunity with operator, and pre-programmed reaction. Continue development of operations. Continue development of command, control and information display for multiple UAVs conducting simultaneous imaging missions using a single UAV operator. Continue development of software technologies that permit single frequency multi-point communications between multiple UAVs and their ground station.
- Complete the Network-Centric Navigation task by demonstrating the transfer of the Precision Time and Time Interface (PTTI) using a suitable DoD Communications Network such as the Advanced Digital Network System (ADNS) using Network Time Protocol (NTP) and other protocols. The GPS and Navigation Device threat analysis will continue the investigation of the most promising approaches for the elimination of the threats to the use of GPS and other navigation devices. The FY05 plan involves further development of Network-Centric areas focused

on implementation. GPS/INS and GPS CRPA efforts will address plans for field testing and work needed for transition to fleet implementation.

- The UCAV-N effort will continue operational concept development and analysis, complete design of subsystem components, and continue design and development of MCS software.
- The MRO will conduct a Demonstration of component survivability through a system demonstration test of all hardware, including the dynamic dispense and control of a sub warhead capable of penetration. Also demonstrated will be the ability to use adaptive control to adjust the in-flight retargeting and control of a sub-warhead after release from the missile.
- In the TSSS effort, the RAD HARD System Design Tool task completes with beta trials of the software deliverable and emphasis will be placed on final documentation and future software maintenance. The SRM ignition response effort completes code validation and verification with flight test data. A flight of opportunity will be planned to acquire necessary flight data for comparison. The Drag Reduction Devices task completes the development of an aero elasticity tool suited for performance prediction of missiles with drag reduction devices. Emphasis will be on making predictions for future aerospike concepts, model documentation and future software maintenance. For the accelerometer task, Proof of Concept, Superconducting and Atom Interferometer, Gravity Gradient Sensors and a new technology accelerometer for FOGN will be tested and final reports published. Plan to complete integration of the UWL handbook, complete Validation and Verification (V&V) of the Integrated Launch Models, and begin final V & V of the Intelligent systems (EDA).
- The FY05 Missile propulsion effort continue subscale static motor test to measure erosion and continue subscale chamber design and hydroburst tests. The Advanced PBCS effort will develop thermal/mechanical valve and flow impingement models. The Ordnance Initiation technology effort will conduct design reviews and purchase prototype systems for evaluation. The Missile electronics task will continue the development of models to track and predict the effects of physical, chemical, and nuclear effects on the operation and reliability of the missile electronics. The Navigation Sonar task will develop a common electronics architecture to accommodate affordable hardware.
- The SSCM NAI technology base program will fabricate turbine engine components using rapid prototyping techniques and advanced materials and manufacturing approaches. Rig testing will be started to validate component design predictions under simulated engine conditions using highly instrumented test articles. Airframe components will be tested under realistic conditions. Manufacturability and affordability of airframe and engine components will be assessed.

	FY 02	FY 03	FY 04	FY 05
Support for Naval Expeditionary Forces Ashore	23,448	26,543	29,569	30,015

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

Budget Activity: 2

PROGRAM ELEMENT: 0602114N Project Title: Power Projection
PROGRAM ELEMENT TITLE: Power Projection Applied Research Applied Research

The focus of this effort is on those technologies that will support expeditionary operations of marines operating in the littoral areas. Some of the technologies developed in this effort include: advanced gun launched seekers and propulsion techniques that will provide more accurate Naval Fire Support (NFS) at longer ranges, Unmanned Ground Vehicles (UGV) development to provide improved surveillance/targeting support to marines on the ground, smart sensor networks to link UAVs in urban environments, and improved explosive formulations that will provide greater lethality against NFS type targets.

FY 2002 ACCOMPLISHMENTS:

- The Autonomous Operations (AO) Unmanned Undersea Vehicle (UUV) task developed enabling technologies in autonomy, navigation, sensors, energy, and communication in support of UUV missions. Initiated development of UUV-deployed Intelligence, Surveillance and Reconnaissance (ISR) electro-magnetic and electro-optic (EM/EO) sensors; software to detect, evaluate and avoid obstacles and threats using various sensor inputs; sensor data fusion for situational awareness; and integrated autonomous UUV control approaches for Maritime Reconnaissance mission capabilities. Developed multi-vehicle undersea search and survey and communication link.
- The AO UAV propulsion and power technology development task for the Navy UAV refined Navy UAV propulsion technologies through individual component design, fabrication and component rig testing under realistic operational conditions under the Integrated High Performance Turbine Engine Technology (IHPTET) program. Demonstrated the UAV engine component technologies that will provide high performance and robust operational utility, reduce parts count and decrease component costs when integrated into an advanced UAV turbine engine.
- The AO Intelligent Autonomy task developed system and associated sensor processing for unmanned vehicles to enable adaptation and independent actions. Developed architecture for combining reactive and deliberative behaviors for autonomous vehicles.
- The Unmanned Ground Vehicle (UGV) program worked on developing technologies that address capability gaps in robotic communications and control, mobility, survivability, durability, modularity, and signature reduction in support of the Marine Corps Gladiator Tactical Unmanned Ground Vehicle (TUGV) program.
- The Micro UAV sensor program demonstrated a magnetic fiber micro sensor and completed the development of a radiometer.
- Smart sensor network effort evaluated and demonstrated different sensor packages linked to form a grid for surveillance and tracking of targets in urban environments.
- The Enhanced Target Acquisition & Location System (ETALS) effort developed an advanced, affordable, azimuth sensing Micro-Electro-Mechanical-Sensor (MEMS) based gyroscope. ETALS will enable improved and more rapid targeting when operating in urban environments and areas of high iron concentration. Developed a gyrocompass model for ETALS. Performed ETALS Selective Availability Anti-Spoofing Module (SAASM) integration test and MAGU-1 (Miniature Azimuth Gyrocompass Unit) gyrocompass test.
- The Weapons program Precise Tactical Targeting (PTT) task began ground and aircraft testing. The Energetic gun propulsion began preliminary support to the barrel wear and advanced propulsion FY03 tasks. The High

Energy Density Materials (HEDM) task continued performance enhancement evaluation of selected HEDM candidates.

FY 2003 PLANS:

- Continue development of AO UUV-deployed ISR electro-magnetic and electro-optic (EM/EO) sensors; software to detect, evaluate and avoid obstacles and threats using various sensor inputs; sensor data fusion for situational awareness; and integrated autonomous UUV control approaches for Maritime Reconnaissance mission capabilities. Continue multi-vehicle undersea search and survey and communication link development.
- The AO UAV propulsion and power technology development effort for the Navy UAV will continue refining Navy UAV propulsion technologies through individual component design, fabrication and component rig testing under realistic operational conditions under the IHPTET program. Demonstrate the UAV engine component technologies that will provide high performance and robust operational utility, reduce parts count and decrease component costs when integrated into an advanced UAV turbine engine. Develop and rig test a high flow combustor under Mach 3.5 conditions. Rig test low pressure spool component of the demonstrator turbine engine.
- The AO Intelligent Autonomy task will develop system and associated sensor processing for unmanned vehicles to enable adaptation and independent actions. Develop architecture for combining reactive and deliberative behaviors for autonomous vehicles.
- The UGV program will develop technologies that address capability gaps in robotic communications and control, mobility, survivability, durability, modularity, and signature reduction in support of the Marine Corps Gladiator Tactical Unmanned Ground Vehicle (TUGV) program.
- Develop ETALS Target Location Designation and Handoff system (TLDHS) interface prototype. Develop AN/GVS-5 production interfaces for ETALS. Perform a Limited User Test for the AN/GVS-5 and TLDHS.
- To complete the Micro UAV Sensor program, a micro acoustic sensor will be demonstrated and, along with the other sensors developed by the program, they will be made available for Micro UAV applications.
- To complete the Smart sensor Network, sensors will be linked into a grid to demonstrate different sensor packages observing and tracking targets in urban environments.
- Initiate the Advanced Gun Barrel and propulsion task which will develop a complete, next generation, gun barrel design for current and future Naval gun systems. This system will yield significant improvement in barrel life and gun system performance. Tasks will involve analysis of thermal transfer between materials and load transfer between layers. Structural and thermal predictive models will be developed.
- The Weapons program PTT task will complete ground and aircraft testing and begin the 1-meter targeting effort. The HEDM task will continue performance enhancement evaluation of selected HEDM candidates and continue fabrication and testing of HEDM structural composites. An effort will be initiated to address moving targets using tactical/expeditionary assets such as tactical UAVs and guided projectiles. An effort will be initiated to further the technologies needed for next-generation high performance gun systems for land attack (light gas or EM).

FY 2004 PLANS:

- Continue development of AO UUV-deployed ISR EM/EO sensors; software to detect, evaluate and avoid obstacles and threats using various sensor inputs; sensor data fusion for situational awareness; and integrated autonomous UUV control approaches for Maritime Reconnaissance mission capabilities. Continue multi-vehicle undersea search and survey and communication link development.
- The AO UAV propulsion and power technology development effort for the Navy UAV will complete refining Navy UAV propulsion technologies through individual component design, fabrication and component rig testing under realistic operational conditions under the IHPTET program. (The program will continue to leverage IHPTET technologies until the program's completion in FY 04.) Rig test the forward swept fan and the high flow combustor for the demonstrator engine under simulated engine conditions. Bench test the low pressure spool power generator and distribution system.
- The AO Intelligent Autonomy task will continue development of system and associated sensor processing for unmanned vehicles to enable adaptation and independent actions. Continue development of architecture for combining reactive and deliberative behaviors for autonomous vehicles.
- The UGV program will complete development and demonstrate technologies that address capability gaps in robotic communications and control, mobility, survivability, durability, modularity, and signature reduction in support of the Marine Corps Gladiator TUGV program.
- ETALS will complete the full mechanical, electrical, and software interfaces between MAGU-1 and the TLDHS Lightweight Laser Designator/Rangefinder (LLDR) and will be documented so as to be suitable for full production. The MAGU-1 gyroscope replacement will leverage the AN/GVS-5 operational testing to verify that the MAGU-1 is operationally suitable for the planned replacement for the AN/GVS-5. Complete test reports and demonstrations will be conducted as part of the operational testing. Full Operational Capability will occur when base system fielding and personnel training is complete.
- The Autonomous Mobile Platform program develops and refines technologies to enable creation of small sensor platforms capable of extended endurance and relocation after initial deployment. Develop propulsion/energy storage/replenishment, and navigation/guidance systems. Begin locomotion experiments.
- The Advanced Gun Barrel Technology effort develops technologies in refractory materials, coating/liner application processes, metal matrix composites, and integrates them into two advanced barrel concepts for use on the DD(X) ship. A subscale gun barrel will be fabricated and tested to demonstrate the capabilities for enhanced barrel life using advanced interior coatings operating at high temperatures and pressures, and will be used to validate models and determine life cycle design constraints. Additionally, composite barrel designs

will be completed showing the fabrication techniques required for industry to produce composite large caliber gun barrels, and validation testing of these models will be conducted on various structural subcomponents.

FY 2005 PLANS:

- Continue development of AO UUV-deployed ISR EM/EO sensors; software to detect, evaluate and avoid obstacles and threats using various sensor inputs; sensor data fusion for situational awareness; and integrated autonomous UUV control approaches for Maritime Reconnaissance, Undersea Search and Survey, and Communication and Navigation Aid mission capabilities. Continue multi-vehicle undersea search and survey and communication link development.
- The AO UAV propulsion and power technology plans to leverage and refine naval UAV propulsion technologies. Leverage the commercial advanced core (high-pressure spool technologies) engine efforts being developed for the next generation business/regional jet engines Ground test UAV demonstrator engine. Demonstrate low pressure spool electrical generator. Ground test a Mach 3.5 capable expendable turbine engine for missile applications and achieve IHPTET phase III Thrust/Air Flow and cost goals.
- The AO Intelligent Autonomy task will continue development of system and associated sensor processing for unmanned vehicles to enable adaptation and independent actions. Continue development of architecture for combining reactive and deliberative behaviors for autonomous vehicles.
- Autonomous Mobile Platform effort will integrate energy replenishment and storage with a refined mobile platform and demonstrate replenishment and relocation operation.
- The Advanced Gun Barrel Technology program develops technologies in refractory materials, coating/liner application processes, metal matrix composites, and integrates them into two advanced barrel concepts for use on the DD(X) ship. Preparations for full scale fabrication of a prototype 155mm gun barrel with advanced interior coatings will begin in the manufacturing process. A series of production tests and checks will be performed in preparation in using the resulting test barrel in life fire testing. Additionally, preparations for more advanced functionally graded material designs will be completed and prepared for manufacture, including the fabrication of a composite barrel test section to validate design models and tools. Preparations for a full scale advanced composite gun barrel with advanced coatings will be determined prior to the end of the fiscal year.

Congressional Plus-Ups:

	FY 02	FY 03
Combustion Light Gas Gun	3,363	N/A

Combustion Light Gas Gun: Developed options for cryogenic storage and handling, gas fuzing and electronic ignition of the propellant gas used in the gun. In addition Computational Fluid Dynamic (CFD) modeling and systems analysis was performed to identify scaling parameters for future gun systems.

	FY 02	FY 03
Fast Pattern Processor, SLAM-ER	1,921	N/A

Fast Pattern Processor, SLAM-ER: This effort developed a dedicated Application Specific Integrated Circuit (ASIC) implementation of algorithms that perform correlation based Automatic Target Recognition (ATR). These pattern recognition algorithms will perform rapid comparison of stored and real time images, using gradient and frequency transformations, to emphasize features of military targets that can be correlated.

	FY 02	FY 03
Hybrid Fiber Optic/Wireless System for Secure Communications	1,348	977

Hybrid Fiber Optic/Wireless System: Developed a millimeter wave, optical transmitter that will generate the optical and millimeter carriers within a mode-locked microchip laser. The laser will operate an eye safe optical wavelength of 1.55mm with a millimeter modulation of 60 GHz for covert communications.

	FY 02	FY 03
Interrogator for High Speed Retro Reflectometer and Hyperspectral SAR	4,046	1,663

Hyperspectral SAR: Develops 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.

	FY 02	FY 03
Integrated Biological & Chemical Warfare Defense Technology Platform/ Phase II	2,401	3,914

Integrated Biological & Chemical Warfare Defense Technology Platform: This effort supports development of a small, low powered chemical sensor and expands the Research and Development to include a biological detection capability. Semi-conducting Metal Oxides (SMO's) will be used for chemical detection and it is anticipated that molecular beacons will be developed for biological weapon detection.

	FY 02	FY 03
Real World Based Immersive Imaging	1,200	1,956

Real World based Immersive imaging: 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 02	FY 03
Naval Precision Strike (SAR for All Weather Targeting)	2,882	6,846

Naval Precision Strike (SAR for All Weather Targeting): This effort will develop 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 02	FY 03
Accelerate Development of Low Cost SWARM UAV	N/A	2,444

Accelerate the development of low cost SWARM UAV: This effort will accelerate the development of Smart Warfighting Array Reconfigurable EO/IR RF modules (SWARM) for long endurance Small Unmanned Aerial Vehicles (UAV).

	FY 02	FY 03
High Efficiency Piezoelectric Crystals	N/A	1,711

High Efficiency Piezoelectric Crystals: Development of piezoelectric devices based on new growth techniques to dither infrared focal plane arrays for extremely high resolution.

	FY 02	FY 03
Millimeter Wave Infrared Imaging	N/A	1,663

Millimeter Wave Infrared Imaging: Work will be performed 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 02	FY 03
Panoramic Night Imaging System	N/A	3,326

Panoramic Night Imaging Systems: This effort will develop large area infrared focal plane arrays and associated signal processing, including imaging systems and sensor evaluation.

	FY 02	FY 03
Tunable Oxide Film and Capacitor Tech & Integration of Oxide Film and Wide Bandgap Semiconductor Tech for the Adv Multi function RF system	N/A	1,663

Tunable Oxide Film and Capacitor Tech & Integration of Oxide Film and Wide Bandgap Semiconductor Tech for the Adv Multi function RF system: Develops the feasibility of integrating electro-optic films into semiconductor microwave device structures.

	FY 02	FY 03
Ultra Short Pulse Laser Micromachining	N/A	1,247

Ultra Short Pulse Laser Micromachining: This effort will develop near-term, ultra short laser micromachining for electronics and fuel injectors.

	FY 02	FY 03
Low Cost Fused Remote Sensors	N/A	977

Low Cost Fused Remote Sensors: Develop 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 02	FY 03
Miniaturized High Definition Digital Camera	N/A	977

Miniaturized High Definition Digital Camera: Develop flight worthy, high definition, color video surveillance camera for a small (4 ft) unmanned aerial vehicle.

	FY 02	FY 03
Pulse Detonation Engine Risk Reduction	N/A	1,027

Pulse Detonation Engine (PDE) Risk Reduction: Design, fabricate and test a compound flow nozzle system for a 5 combustor test vehicle. Conduct structural and thermal analysis of alternative engine configurations.

	FY 02	FY 03
Printed Wiring Board Manufacturing	0	*

(*$3,325 appropriated in PE 0602234N)

The printed wiring board (PWB) effort will focus on computer aided design/computer aided manufacturing using three process technologies (a) laser ablation and metallization, (b) high velocity particle consolidation of metal powers, and (c) acoustic microscopy for PWB that will revolutionize PWB manufacturing and reverse engineering for Navy systems.

	FY 02	FY 03
Real Time Infra-Red Scene Generator	0	*

(*$977 appropriated in PE 0603712N)

Development of a real-time infrared scene simulator integrated circuit for infrared sensors and missile seekers performance testing and built in test.

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 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602123N
PROGRAM ELEMENT TITLE: Force Protection Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Force Protection Applied Research	133,261	118,413	75,909	98,763	99,329	126,541	125,286	122,150

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 by virtue of improvements in platform offensive performance, stealth and self defense. This program supports the Fleet and Force Protection and Missile Defense Future Naval Capabilities (FNC).

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

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	130,870	89,390	80,864	77,540
Adjustments from FY 2003 President’s Budget:				
Congressional Plus-Ups		31,725		
SBIR Reduction	-2,870			
Execution Adjustments	5,918			
Congressional Rescissions/Adjustments/Undistributed Reductions	-657	-1,417		
S&T Program Adjustments			-2,019	24,525
NWCF Rate Adjustments			-214	-15
Efficiencies at NWCF Activities			-765	-791
Pay Raise/Inflation Adjustments		-1,285	-1,957	-2,496
FY 2004/2005 President's Budget Submission:	133,261	118,413	75,909	98,763

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602123N
PROGRAM ELEMENT TITLE: Force Protection Applied Research

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not Applicable.
Technical: Not Applicable.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602123N Project Title: Force Protection
PROGRAM ELEMENT TITLE: Force Protection Applied Research Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Force Protection Applied Research	133,261	118,413	75,909	98,763	99,329	126,541	125,286	122,150

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B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Surface Ship & Submarine Hull Mechanic & Electrical (HM&E)	$63,215	$44,989	$45,964	$61,438

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 addressees 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 and Missile Defense Future Naval Capabilities (FNC).

FY 2002 ACCOMPLISHMENTS:

Signature Reduction:

Initiated:

- For Submarines - Development of analytical models to further define modular submarine hull concepts.
- For Surface Ships – Basic planning of tow tank acoustic tests and numerical model of uncoated surface combatant hulls for surface ship acoustic program. Antenna isolation measurement for both high band and low arrays integrated into topside structures. Assessment of technology options for electromagnetic, thermal, electro-optical and visual signature reduction of Low-Observable Integrated Deckhouse (LID). Assessment of susceptibility of surface ships electrical fields causing mines to trigger for Near Field Deamping program.

Continued:

- For Submarines - Evaluation of control algorithms for advanced degaussing/de-amping of submarine hulls. Development of advanced numerical acoustic codes and gridding methods for those codes. Assessment of internal foundation structure impact to hull response to excitation/propulsion drive types. Actuator component acoustic evaluations.
- For Surface Ships - Development of physics based numerical model for electromagnetic scattering of hydrodynamic disturbances.

Completed:

- For Submarines - Feasibility study to develop realizable modular hull/payload modules. Analysis of full-scale trial data to establish hull response and radiated noise levels with hull treatments applied.
- For Surface Ships - Validation of numerical model to predict the eddy current contribution to magnetic signatures. Assessment of both internal and external degaussing coil arrangements. Recommendations for physics and software architecture for the next-generation infrared scene model.

Hull Life Assurance:

Initiated:

- Component design for dynamic ship protection. Study of Advanced Design Hardening Methods for hull structure design for Stainless Steel Advanced Double Hull (SSADH), Composite Hybrid Hull and other hull forms. Dynamic Behavior of Composite Ship Structures (DYCOSS) joint effort with Dutch Navy. Development of tools to describe failure mechanisms of sandwich composites.

Continued:

- Definition of composite hull structural failure modes and mechanisms, development of design concepts and design guidance for composite structural details. Design tool for integrated antenna and composite topside. Reliability based design and structural analysis code development.

Completed:

- Analytical tool development for dynamic ship protection system. Demonstration of the fiber-optic health monitoring system on the RV-Triton during rough weather trials. Characterization of composite hull shock response with shock table tests on topside joints. Analysis of results for composite hull shock tests performed in the Baltic Sea (joint effort with Germany).

Hydromechanics:

Continued:

- For Submarines - Improved maneuvering simulation capability. Study of flow noise over control surfaces. Development of experimental methods to control/eliminate the cavitation and apply to model-scale propellers.
- For Surface Ships - Numerical prediction of hydrodynamic disturbances generated by surface ships. Development, validation, and application of numerical codes to integrated propulsor/hull for advanced surface ship configurations. Development of prediction methods relating hydrodynamics and ship signatures.

Completed:

- For Submarines - Comparison of computational and experimental results for a looped-blade propulsor concept and design a looped-blade propeller for a full-stern propulsor. Maneuvering experiments using existing/modified propulsor hardware from the USS VIRGINIA and Office of Naval Research (ONR) Advanced Stern Programs.
- For Surface Ships - Demonstration and evaluation of the variable pitch prop design.

Distributed Intelligence for Automated Survivability:

Initiated:

- Assessment of explosion mitigation through preemptive use of water mist for advanced damage countermeasures.

Completed:

- Investigation of fire and smoke spread modeling for damage control. Automated damage control effort to provide design criteria for automated systems.

Advanced Electrical Power Systems:

Initiated:

- Support of power & energy research Centers of Excellence, Electric Power Consortium, including major test and instrumentation needs, for such things as advanced prototype testing, Superconducting Magnetic Energy Storage (SMES), and other applications of superconductivity, as well as, power and control systems.
- Studies to define advanced system state estimation concepts for controls and sensors. Development of technology basis for a family of electromechanical actuators. Advanced thermal management concepts and components. Design of system manager for Universal Control Architecture.

Continued:

- Evaluation of the potential of impact wafer bonded Fast Turn Off Switch (FTO) for future Navy systems. Evaluation of potential applications of silicon-carbide in future high voltage and high power applications. Development of advanced power system and control architectures for operation and reconfiguration of future all-electric ships. Demonstrate power electronics technology to reduce the size, weight and cost of Electromagnetic Aircraft Launch System (EMALS) and Electromagnetic Aircraft Launch Recovery System (EARS).

Completed:

- Demonstration of advanced passive components for high voltage application. Development of new hierarchical control architecture for power systems, Universal Control Architecture (UCA).

FY 2003 PLANS:

Signature Reduction:

Initiate:

- For Submarines – Development of acoustic wireless sensor array concept.
- For Surface Ships – Development of next generation infrared (IR) scene model.

Continue:

- For Submarines - Development of advanced numerical acoustic codes and gridding methods for those models. Continue development of analytical models to further define modular submarine hull concepts. Algorithm/finite element model validation for submarine advanced degaussing/deamping.
- For Surface Ships - Development of physics based numerical model for electromagnetic scattering of hydrodynamic disturbances. Continue surface ship acoustic program efforts with a flow noise model development.

Complete:

- For Submarines - Notional baseline payload module for modular hull application. Assessment of internal foundation structure impact to hull response to excitation/propulsion drive types. Actuator component acoustic evaluations.
- For Surface Ships - Tank test for surface ship acoustic behavior validation. Antenna isolation measurement for both high band and low arrays integrated into topside structures. The preliminary version of Next Generation IR Code for verification and validation.

Hull Life Assurance:

Continue:

- Assessment of alternative structural concepts for improving performance of combatant ship structures. Technologies assessed include Stainless Steel Advanced Double Hull (SSADH), composite primary hull, hybrid steel and composite hulls, and composite topsides. Design tool for integrated antenna and composite topside. Develop tools to describe failure mechanisms of sandwich composites. Reliability based design and structural analysis code development.

Complete:

- Definition of composite hull structural failure modes and mechanisms, development of design concepts and design guidance for composite structural details. Component design for dynamic ship protection system. Study on Advanced Design Hardening Methods for hull structure design for SSADH, Composite Hybrid Hull and other hull forms. Dynamic Behavior of Composite Ship Structures (DYCOSS) joint effort with Dutch Navy.

Hydromechanics:

Initiate:

- For Submarines - Model testing of a looped-blade propeller with a full stern to characterize powering, cavitation, acoustic, and maneuvering performance. Evaluation of internal pump submarine propulsor.

Continue:

- For Submarines - Improved maneuvering simulation capability. Develop experimental methods to control/eliminate the cavitation and apply to model-scale propellers. Study of flow noise over control surfaces.
- For Surface Ships - Development, validation, and application of numerical codes to integrated propulsor/hull for advanced surface ship configurations. Numerical prediction of hydrodynamic disturbances generated by surface ships. Development of prediction methods relating hydrodynamics and ship signatures.

Complete:

- For Submarines - Design and fabrication of loop bladed propeller. Experimental methods to control/eliminate the cavitation and apply to model-scale propellers.

Distributed Intelligence for Automated Survivability:

Continue:

- Assessment of explosion mitigation through preemptive use of water mist for advanced damage countermeasures.

Advanced Electrical Power Systems:

Continue:

- Studies to define advanced system state estimation concepts for controls and sensors. Development of technology basis for a family of electromechanical actuators including development of design requirements for actuators. Investigation of advanced thermal management concepts and components. Development of compact high-powered solid state switching technology for the EMALS and other pulsed and steady state applications. Development of advanced power system and control architectures for operation and reconfiguration of future all-electric ships. Support of power & energy research Centers of Excellence, including major test and instrumentation needs, for such things as advanced prototype testing, SMES, and other applications of superconductivity, as well as, power and control systems. Evaluation of potential applications of silicon-carbide in future high voltage and high power applications.

Complete:

- Evaluation of the potential of impact wafer bonded FTO for future Navy systems.
- Transition of demonstration Hardware, Application, and System Managers to advanced EMALS program Commercial Power Electron Building Block (PEBB) based utility products available for Navy application. Design of system manager for Universal Control Architecture (UCA).

FY 2004 PLANS:

Signature Reduction:

Continue:

- For Submarines - Development of advanced numerical acoustic codes and gridding methods. Continue development of modular submarine hull concepts.
- For Surface Ships - Development of next generation IR scene model by development of mitigation strategy supporting low observable infrared platforms, development of supporting physics and prototype measurement techniques. Develop a small-scale surface ship acoustic test plan for hull flow noise model validation of previous year's model. Development of physics based model of electromagnetic scattering of hydrodynamic disturbances.

Complete:

- For Submarines - Fabrication of prototype acoustic wireless sensor array concept.

Hull Life Assurance:

Initiate:

- Development of structural concepts identified in FY03 assessment of structural system performance. System demonstration of dynamic ship protection system.

Continue:

- Reliability based design and structural analysis code development. Design tool for integrated antenna and composite topside. Development of tools to describe failure mechanisms of sandwich composites.

Complete:

- Assembly of dynamic ship protection system.

Hydromechanics:

Initiate:

- For Submarines - Design and construction of test equipment for internal pump submarine propulsor.

Continue:

- For Submarines – Improvement of maneuvering simulation capability. Study of flow noise over control surfaces.
- For Surface Ships - Numerical prediction of hydrodynamic disturbances generated by surface ships. Development of prediction methods relating hydrodynamics and ship signatures.

Complete:

- For Submarines - Model tests of loop bladed propeller characterizing powering, cavitation, acoustic and maneuvering performance. Performance prediction for internal pump submarine propulsor.
- For Surface Ships - Development, validation, and application of numerical codes to integrated propulsor/hull for advanced surface ship configurations. Validation of advanced prediction code for large amplitude non-linear motion of advanced surface ship hulls.

Distributed Intelligence for Automated Survivability:

Continue:

- Assessment of explosion mitigation through preemptive use of watermist for advanced damage countermeasures.

Complete:

- Test facility demonstration of watermist based blast mitigation system.

Advanced Electrical Power Systems:

Initiate:

- Development of Fast Turn Off Switch (FTO) based Power Electron Building Block (PEBB). Development of silicon carbide power switch. Dynamically reconfigurable electric distribution system demonstrations.
- Development of advanced power generation technologies, including high power density fuel cells for shipboard use. Investigate innovative approaches to diesel fuel reforming.

Continue:

- Studies to define advanced system state estimation concepts for controls and sensors. Support of power & energy research Centers of Excellence, including major test and instrumentation needs, for such things as advanced prototype testing, SMES, and other applications of superconductivity, as well as power and control systems. Development of advanced power system and control architectures for operation and reconfiguration of future all-electric ships.

Complete:

- Transition advanced thermal management concepts and components. Provide design and test data transition of electric actuator design.

Advanced Energetics:

Initiate:

- Technology development for the next generation reactive material (formulations, material properties and lethality models) for high density reactive materials and novel reactive structural materials.
- Development of difluoramine ingredient and formulations as candidates for next generation explosives and propellants.
- Development of advanced directed energy warheads, exploiting novel explosive and reactive material concepts.

FY 2005 PLANS:

Signature Reduction:

Continue:

- For Submarines - Development of advanced numerical acoustic codes and gridding methods. Development of modular submarine hull concepts.

Complete:

- For Submarines - Demonstration of prototype acoustic wireless sensor array system incorporating self powering, radio frequency unit and sensors. Control algorithms for advanced degaussing/de-amping of submarine hulls.
- For Surface Ships – Deliver next generation IR scene model and next generation IR code.

Hull Life Assurance:

Continue:

- Structural system concept development previously identified. Reliability based design and structural analysis code development. Design tool for integrated antenna and composite topside. Develop tools to describe failure mechanisms of sandwich composites. System demonstration of dynamic ship protection system.

Complete:

- System demonstration of dynamic ship protection system.

Hydromechanics:

Continue:

- For Submarines - Improved maneuvering simulation capability. Construction and test of equipment for internal pump submarine propulsor.
- For Surface Ships - Numerical prediction of hydrodynamic disturbances generated by surface ships.

Complete:

- For Submarines - Quiet control surface design tool based on control surface flow noise studies.
- For Surface Ships - Validate prediction methods relating hydrodynamics and ship signatures.

Distributed Intelligence for Automated Survivability:

Complete:

- Full-scale test demonstration of watermist based blast mitigation.

Advanced Electrical Power Systems:

Continue:

- Studies to define advanced system state estimation concepts for controls and sensors. Support of power & energy research Centers of Excellence, including major test and instrumentation needs, for such things as advanced prototype testing, SMES, and other applications of superconductivity, as well as power and control systems. Development of advanced power system and control architectures for operation and reconfiguration of future all-electric ships. Dynamically reconfigurable electric distribution system demonstrations. Development of FTO based PEBB. Development of Silicon Carbide power switch. Advanced power generation program, including high power density advanced fuel cells and innovative diesel fuel reforming.

	FY 02	FY 03	FY 04	FY 05
Advanced Energetics	$8,107	$11,000	$0	$12,800

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, and ultimately to transition advanced technology to the Fleet. 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 2002 ACCOMPLISHMENTS:

Initiated:

- Advanced Energetics effort (Navy component of the Defense Threat Reduction Agency led Thermobaric Weapon Advanced Concept Technology Demonstration (ACTD)). Navy responsibility was payload development. Tasks included development of the explosive fill, subscale testing of material, scale up through full scale validation, and ultimately qualification.

FY 2003 Plans:

Continue:

- Advanced energetics development of composition synthesis and process for the Thermobaric Warhead Explosive Fill ACTD.

Complete:

- Applied research portion of Advanced Energetics effort in Thermobaric Weapon ACTD. PE 0602123N takes the effort through subscale payload testing portion of the development in FY03. Remainder will be picked up in Advanced Energetics under PE 0603123N in FY04.

FY 2004 Plans:

Moved to HM&E activity

FY 2005 Plans:

Continue efforts initiated in HM&E activity:

- Technology development for the next generation reactive material (formulations, material properties and lethality models) for high density reactive materials and novel reactive structural materials.
- Development of difluoramine ingredient and formulations as candidates for next generation explosives and propellants.
- Development of advanced directed energy warheads, exploiting novel explosive and reactive material concepts.

	FY 02	FY 03	FY 04	FY 05
Sensors & Associated (S&A) Processing	$14,850	$12,400	$12,619	$8,311

Activity focuses on applied research for complementary sensor and processing technologies for 21st century warfighting success and platform protection. Current small platforms (both surface and airborne) have little to 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 multispectral (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 multispectral detection and distribution of specific threat information. This activity supports the Fleet and Force Protection and Missile Defense Future Naval Capabilities (FNC).

FY 2002 ACCOMPLISHMENTS:

Distributive Aperture System (DAS):

Initiated:

- For Surface Ships - The Navy began advanced research for the development of a ship based DAS Infrared Search and Track (IRST) for DDX, CGX, and CVNX platforms. The DAS addressed future surface combatant needs to win or avoid engagements by weapons and platforms, and asymmetric threats faced in the littorals. The DAS program investigated, examined and evaluated new technologies and techniques for focal plane arrays, anamorphic optics, stabilization techniques, modularized replaceable packaging, and high-speed processors and algorithms. The DAS sensor, consisting of eight modules for surface ships varied based on the size of ship. It provided surface ships with a 360-degree panoramic staring view on the horizon to line of sight, and detected, declared, and tracked air contacts and surface contacts within 2-3 seconds. The sensor modules can pan downward to view the surface from near the ship to line of sight for in port counter terrorism awareness. DAS addressed the surface naval ships needs for a passive fighting ability and in-port security capability. Two International FY02 Project Agreements (United Kingdom and Australia) assisted the DAS program in the development of sensor, signal processing algorithms, and high-speed technologies.
- For Surface Ships - A Shipboard EO/IR Closed Loop Self Protection project development for the demonstration of an integrated threat detection, classification, and closed loop laser jamming system to counter EO/IR/Laser guided anti-ship missiles. This was done by using a multi-line high power laser system operating in the visible to longwave IR spectral band; a rangefinder that ranged passive targets out to 20km; and a transceiver and signal processor that classified a target in less than 3 seconds.
- For Naval Aircraft - As anti-air threat missile systems increase in both number and technical sophistication, the Navy has developed a Missile Warning System (MWS) effort that uses a solid-state two color staring sensor and tracking system to provide aircraft systems with the detection, location and identification of sophisticated threat missiles with the fidelity required to queue laser-based directional infrared countermeasures (DIRCM) systems and launch off-board decoys. The MWS system demonstrated a Time to go (TTG) accuracy of +/- 15% for missile ranges greater than 1.5 kilometers and a 75% increase in the minimum detection range for Man Portable Air Defense Systems (MANPADs) with no increase in the false alarm rate.
- For Naval Aircraft - The EO/IR Laser Jammer for Tactical Aircraft (TACAIR) effort focused on components related to the jamming portion of the DIRCM system that also included the MWS project. These components included technology enhancements to the power and beam characteristics of the laser-based countermeasure and demonstrated effective jam codes for all Tier 1 and Tier 2 threat missiles and a common jam code with

95% effectiveness for all Tier 1 and Tier 2 threat missiles. These capabilities enabled tactical aircraft to operate routinely in airspace below 20,000 feet by providing self-protection against current and advanced IR guided missile threats.

- For Small Platforms - EO/IR self-protection for Small Surface Vehicles, part of the Electronic Warfare Integrated System for Small Platforms (EWISSP) project, was initiated to provide a small platform with automatic response self and local area protection against IR guided and laser designated missiles and munitions. Accomplishment was with an integrated system capable of detecting and localizing laser designators and providing missile launch indication at a range of 4 km. The EWISSP effort will be continued under PE0602235N in FY 03.
- For Marine Corps - The End User Terminal (EUT) effort, structured to develop improved personal communications, situational awareness and sniper detection for ground troops that use less power, provide greater range and ease of use, was initiated and will use a central processing unit that delivers the performance similar to the 550 MHz Pentium III but at ¼ the power level. The daylight readable low power display will provide a minimum of 256 colors and an 80% power reduction over existing units.

Completed:

- For Surface Ships - The Shipboard Laser Acquisition System (SBLAS) effort completed fabrication and characterization of an off-axis laser detection system and a decoy subsystem that will become part of the EWISSP project.
- For Naval Aircraft - The Electrical IR Decoy Launcher developed the capability for multiple decoy shots and investigating components and designs for a non-foreign object damage (FOD) less cartridge.

Biocentric Technologies:

Initiated:

- Scale-up and determine yield optimization of green synthesis of energetic materials using enzymes toward an environmentally acceptable production method for energetic materials without the use of hazardous reagents and generation of hazardous by-products.
- Evaluation of sensors for trinitrotoluene (TNT) and other explosives to be used as autonomous underwater vehicle payloads for detection of unexploded ordnance (UXO).
- Feasibility study of energy harvesting benthic fuel cells using bioelectrochemical mechanisms at the water-sediment interface. The goal is to use naturally occurring microbes to harvest low levels of power (~0.1 Watt) on a continuous basis.
- Evaluation of applicability of chemical sensing from autonomous underwater vehicles for Special Forces applications.

Continued:

- Chemical Sensing in the Marine Environment effort, for locating the source of chemical plumes in very shallow waters using sensors on autonomous underwater vehicles. This will provide the Navy with a new capability for the difficult task of remotely identifying UXO in the littoral zone.
- Chemical Sensing in the Marine Environment effort, to characterize chemical plume structure in the very shallow water regime. Previous research indicates that the plume structure is quite variable and heavily dependent on environmental conditions and interactions. Mapping of plume structure under various

environmental scenarios is necessary to guide the development of sensor systems for underwater UXO detection.

- Development of novel biosensors for explosives for underwater applications. These novel biosensor systems will provide sensitive, selective, and rapid detection of explosive signatures (such as TNT), a capability that the Navy currently lacks.
- Work on tailored acoustic materials for quieter platforms.
- Investigation of bio-inspired algorithms for image processing hardware development.
- Development of oligonucleotide taggants as molecular barcodes for Naval applications.
- Development of novel nonporous fouling-resistant enzymatic composite membranes for wastewater treatment.

Completed:

- Transitioned the metallized lipid tubule materials for radar absorbing and antenna isolation applications. These materials show potential as replacement for the existing systems now used for this purpose, displaying competitive absorption properties but weighing approximately 60% less, a very important advantage given the small decoy vehicles on which they are deployed.
- Investigation of bio-molecular barcodes for unique identification and tracing of materials. These barcodes or taggants act as microscopic markers that can be used to trace and identify material of naval interests, e.g., military equipment and personnel, and which have high applicability for counter-terrorism programs.
- Chemical Sensing in the Marine Environment effort to characterize the source strengths of underwater unexploded ordnance. Distance from source and associated concentration profile data will drive the operational requirements necessary to guide the development of sensor systems for underwater UXO detection.

FY 2003 PLANS:

Distributive Aperture System (DAS):

Initiate:

- For Naval Aircraft - Integrated Defensive Electronic Countermeasures (IDECM) effort to add additional capability to the radio frequency countermeasures (RFCM) system for F/A-18 E/F self-protection. This consists of developing an RF decoy towline capable of operating intermittently for 30 seconds at 650 degrees centigrade for 3 minutes total exposure time and applying Gallium Arsenide technology to design a prototype solid-state transmitter for the fiber optic towed decoy.

Continue:

- For Surface Ships – Development of DAS technologies and associated processing with the international partners. Examination and integration of the sensor modules into a single system design to support shipboard combat operations. A high-speed processor and associated algorithms, ported to middleware, is examined for real-time application. Test and verify technologies in laboratories prior to shipboard DAS demonstration. The DAS effort will deliver a three-sensor package with associated processing and high-speed central processor for integration into surface combatants. International partners will mirror the U.S. effort and help to explore, examine, and evaluate the DAS sensor, signal processing algorithms, and high-speed processor technologies to support a FY05/06 demonstration. Develop the data processor and optical augmentation software algorithms for threat classification.

- For Marine Corps - EUT examination of techniques to inject advanced-scope information into its network. Integration of the RF module and the vest/garment. Develop RF transmitters using Gallium Nitride on Silicon Carbide transistor technology. The goal is a factor of 3 improvement in efficiency vs. current man wearable transmitters being used by the Marine Corps Warfighting Laboratory.
- For Naval Aircraft - Missile Warning System (MWS) test improved Time to go (TTG) accuracy conduct live fire demonstrations and tests, and test high temperature focal plane arrays.
- For Naval Aircraft - EO/IR laser jammer for TACAIR. Examine two-color (low operating temperature) Focal Plane Arrays (FPA) for common optics.

Complete:

- For Surface Ships - Shipboard EO/IR closed loop self-protection, development of the optical train design. The repackaging of the mid-wave IR laser completion supports the preparation for a future functional field demonstration.

Biocentric Technologies:

Initiate:

- Development of stochastic chemical sensors for naval applications to provide single molecule detection.

Complete:

- 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 UXO.
- Chemical Sensing in the Marine Environment characterization of chemical plume structure in very shallow water regimes. Optimized search strategies are used onboard an autonomous underwater vehicles (AUV) to trace chemical plume from UXO.
- Development of novel biosensors for explosives for underwater applications. These novel biosensor systems are expected to provide sensitive, selective, and rapid detection of explosive signatures (such as TNT), a capability that is currently lacking but is needed to provide real-time data for swift decision making.
- Discontinue scale-up and optimize the yield of a green synthetic methodology for production of energetic materials using enzymes toward an environmentally acceptable production method for energetic materials without the use of hazardous reagents and generation of hazardous by-products.
- Efforts directed toward using TNT and other explosives sensors as AUV payloads for detection of UXO.
- Discontinue development of energy harvesting benthic fuel cells using bioelectrochemical mechanisms at the water-sediment interface. The goal is to use naturally occurring microbes to harvest low levels of power (~0.1 Watt) on a continuous basis.
- Discontinue investigation of chemical sensing from AUV for Special Forces applications.
- Tailored acoustic materials for quieter platforms.
- Investigation of bio-inspired algorithms for image processing hardware development.
- Development of oligonucleotide taggants as molecular barcodes for Naval applications.
- Development of novel nonporous fouling-resistant enzymatic composite membranes for wastewater treatment.

FY 2004 PLANS:

Distributive Aperture System (DAS):

Continue:

- For Surface Ships - Investigation, development, and testing of components, materials and technology for a DAS sensor module.
- For Naval Aircraft - IDECM design and development of a prototype solid state transmitter for the Fiber Optic Towed Decoy (FOTD) using Gallium Arsenide (GaAs) technology.
- EO/IR Laser Jammer for TACAIR development and testing of a common jam code with 95% effectiveness for all Tier 1 and 2 IR-guided missile threats.
- For Marine Corps - EUT design and development of enhanced RF transmitters using Gallium Nitride on Silicon Carbide (GaN/SiC) transistor technology.

Complete:

- For Surface Ships - Shipboard EO/IR Closed Loop Self Protection system design of the Shipboard Integrated Electro-optic Defense System (SHIELDS).
- For Naval Aircraft - MWS demonstration of a 100% improvement in FPA cryogenic cooling efficiency at elevated ambient temperatures

Biocentric Technologies:

Initiate:

- Development of reagentless sensors for Weapons of Mass Destruction.

Continue:

- Development of stochastic chemical sensors for naval applications to provide single molecule detection.

FY 2005 PLANS:

Distributive Aperture System (DAS):

Continue:

- For Surface Ships - Development of components and packaging for the prototype sensor module for the DAS initial packaged sensor module testing.
- For Surface Ships - Shipboard EO/IR Closed Loop Self Protection design of the multifunction signal processor/controller.
- For Naval Aircraft - IDECM development and testing of the on-board algorithms and software incorporating the latest electronic countermeasures techniques.
- EO/IR Laser Jammer for TACAIR design and development of the solid state pointer tracker system.
- For Marine Corps - EUT development of the mid-wave infrared (MWIR) camera module for the multifunction rifle sight (MFRS).

Biocentric Technologies:

Initiate:

- Development of novel biomimetic propulsion systems for autonomous underwater vehicles.

Continue:

- Design and development of reagentless sensors for Weapons of Mass Destruction.

Complete:

- Development of stochastic chemical sensors for naval applications to provide single molecule detection.

	FY 02	FY 03	FY 04	FY 05
Missile Defense (MD)	$18,900	$10,500	$10,162	$8,771

Missile Defense (MD) applied research develops enabling technology for littoral Theater Air and Missile Defense (TAMD) enhancements for transition to acquisition programs. These enhancements will interact efficiently, effectively, and in time to detect, control, and engage projected anti-ship cruise missiles, overland cruise missiles, aircraft and theater ballistic threats. The Missile Defense Science and Technology (S&T) efforts directly provide elements of the capability required by the Joint Requirements Oversight Council (JROC) TAMD Capstone Requirements Document (CRD) (2001). This effort supports the Missile Defense FNC.

FY 2002 ACCOMPLISHMENTS:

Initiated:

- Littoral Affordability (classified project).
- Directed Energy effort began High Energy Laser (HEL) Analysis Feasibility Study to identify and provide analyses of; (a) those areas deemed necessary to determine the feasibility of deploying HEL weapons aboard U.S. Navy assets and (b) the feasibility of using Free Electron Laser (FEL) as an ordnance system for Fleet Air Defense. Development of preliminary baseline Surface Combatant HEL top level and sub-system requirements, for both Diode Pumped Solid State High Energy Laser (DPSSHEL) and FEL technology based systems, based upon the existing draft USN MNS and anticipated capabilities.
- Using the Army Developed Tactical Cruise Missile System (TACMS) as a basis, conduct feasibility and design efforts for adaptation of this system to a submarine launched TACMS, TACMS-P, for a wide range of precision strike targets.

Continued:

- Distributed Weapons Coordination (DWC), (an evolution from Composite Threat Evaluation / Weapon Assignment (TEWA)), development of algorithms (compatible with an open-architecture combat system) to collate theater-wide sensor use and weapons status for common threat evaluation (CTE) and Preferred Shooter Recommendation (PSR) functions.

Completed:

- Infrared (IR) Sensors effort, which conducted requirements analysis and technical assessment of alternatives for advanced IR sensors for airborne detection of Theater Ballistic Missile (TBM) events. Development and demonstration Navy Terminal Theater Ballistic Missile (TBM) Defense CTE and PSR functionality at a laboratory simulation facility.
- Preliminary Design Review for TACMS-P ACTD. TACMS-P ACTD establishment of interface with the Army Fuze body at Picatinny Arsenal in New Jersey demonstrated fuze safety theme. Hardware has been procured and software development is ongoing.

FY 2003 PLANS:

Initiate:

- Articulation of requirement and methodology for sensor coordination in support of integrated fire control and theater-wide surveillance/tracking.

Continue:

- Littoral Affordability (classified program).
- DWC development of algorithms for the AEGIS Combat System, CTE and PSR functions. Demonstrate Navy Anti-Air Warfare (AAW) combined with terminal TBM defense functionality in a laboratory simulation facility.

Complete

- The TACMS-P ACTD critical review.

FY 2004 PLANS:

Initiate:

- Technology development for the next generation reactive material (formulations, material properties and lethality models) for high density reactive materials and novel reactive structural materials.
- Development of difluoramine ingredient and formulations as candidates for next generation explosives and propellants.
- Development of advanced directed energy warheads, exploiting novel explosive and reactive material concepts.

Continue:

- Littoral Affordability (classified project).
- DWC development of algorithms for the AAW and TBMD functionality of CTE and PSR in the naval open architecture combat system. It will take first steps to demonstrate this capability in an “open system” environment at a contractor facility.

FY 2005 PLANS:

Continue:

- Littoral Affordability (classified program).
- DWC development of algorithms for the naval open architecture combat system, CTE and PSR functions and sensor coordination. Demonstrate Navy and Joint Integrated Air Defense functionality in a laboratory simulation facility.
- Technology development for the next generation reactive material (formulations, material properties and lethality models) for high density reactive materials and novel reactive structural materials.
- Development of difluoramine ingredient and formulations as candidates for next generation explosives and propellants.
- Development of advanced directed energy warheads, exploiting novel explosive and reactive material concepts.

	FY 02	FY 03	FY 04	FY 05

Aircraft Technology	$10,701	$7,000	$5,511	$5,831

Activity develops enabling technology for naval aviation, with emphasis on the demands imposed by aircraft carrier flight operations and Marine Corps amphibious and field operations. This effort exploits emerging technologies of: (a) structures and flight controls to reduce the total life-cycle-cost and extend the operational life of future and legacy air vehicles; (b) reduced observables, (c) aerodynamic designs of Naval-unique aircraft components; (d) advanced electrical power systems for air vehicles; (e) advanced helmet/display systems; and (f) predicting safer, more reliable at-sea operating envelopes. The effort provides mission area analysis and concept definition required for the applied research phase of air vehicle programs.

Applied research efforts address manned and unmanned airborne platform technologies for future joint warfighting capabilities to promptly engage regional forces in decisive combat on a global basis and to employ a range of more suitable actions at the lower end of the full range of military operations, which achieve military objectives with minimum casualties and collateral damage. This activity adheres to Defense Science and Technology (S&T) Reliance Agreements and supports the Department of Defense Science and Technology Strategy, which coordinates and minimizes duplication of aircraft technology efforts. Individual Naval aircraft technology applied research efforts fill Naval Aviation needs that are not met by Air Force, Army, National Aeronautics and Space Administration (NASA), Defense Advanced Research Projects Agency (DARPA) and industry programs.

FY 2002 ACCOMPLISHMENTS:

Initiated:

- Technology demonstration of an all-composite (fatigue & corrosion insensitive) replacement for dynamically loaded control surfaces for tactical aircraft.
- Time-accurate Computational Fluid Dynamics (CFD) modeling of ship airwake flows to provide higher fidelity simulations, enhancing safety.

Continued:

- Abrupt Wing Stall (AWS) figures of merit development and verification, CFD validation, and wind tunnel test techniques to mitigate/eliminate AWS on current/future fighter/attack aircraft.
- Development and simulation of advanced control laws for ship-board auto-land of unconventional vehicles.
- Development and simulation of automated maneuvering algorithms to improve lethality, safety, and survivability for Naval Mission tasks.
- Development of Advanced optics and head tracker of a multi-mode helmet vision system. Transitioned effort to PE 0603216N.
- Development of survivability/reduced observables technology (classified).
- Piloted simulation of intelligent flight control prognostics and reconfiguration algorithms to improve safety, survivability, and affordability of flight control systems.

Completed:

- Flight-testing with DARPA and Boeing of an Unmanned Air Vehicle (UAV) to demonstrate conversion from rotary-wing to fixed-wing flight using a canard/rotor wing concept.

FY 2003 PLANS:

Initiate:

- Investigation of reconfigurable air vehicles.

Continue:

- Technology demonstration of an all-composite replacement for dynamically loaded control surfaces for tactical aircraft.
- Time-accurate CFD modeling of ship airwake flows to provide higher fidelity simulations, enhancing safety.
- Validation through real-time hardware demo of intelligent flight control prognostics and reconfiguration algorithms to improve safety, survivability, and affordability of flight control systems.
- Survivability/reduced observables technology development (classified).

Complete:

- Piloted simulation of intelligent flight control prognostics and reconfiguration algorithms to improve safety, survivability, and affordability of flight control systems.
- Development and simulation of advanced control laws for shipboard auto-land of unconventional vehicles.
- Development and simulation of automated maneuvering algorithms to improve lethality, safety, and survivability for Naval Mission tasks.
- Abrupt Wing Stall figures of merit development and verification, CFD validation, and wind tunnel test techniques to mitigate/eliminate AWS on current/future fighter/aircraft aircraft.

FY 2004 PLANS:

Continue:

- Investigation of in-flight, autonomously reconfigurable air vehicles. This effort includes studies and workshops to define this revolutionary-type of air platform concept. This effort will include the leveraging of results from methodology, theory and model development of fatigue & corrosion-insensitive structures, ship-aircraft airwake computational capability, and intelligent flight control prognostics & reconfiguration algorithms.
- Survivability/reduced observables technology development (classified).

Complete:

- Validation through real-time hardware demo of intelligent flight control prognostics and reconfiguration algorithms to improve safety, survivability, and affordability of flight control systems.

FY 2005 PLANS:

Continue:

- Investigation of in-flight, autonomously reconfigurable air vehicles. This effort includes studies and workshops to define this revolutionary-type of air platform concept. This effort will include the leveraging of results from methodology, theory and model development of fatigue & corrosion-insensitive structures, ship-aircraft airwake computational capability, and intelligent flight control prognostics & reconfiguration algorithms.
- Survivability/reduced observables technology development (classified).

Complete:

- Validation through component demonstration of methodology for the design & analysis of fatigue & corrosion insensitive aircraft structure (control surface).

	FY 02	FY 03	FY 04	FY 05
Underwater (UW) Platform Self Defense	$3,100	$1,500	$1,653	$1,612

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, high speed torpedoes, 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 on board ship. Technologies should be developed to minimize shipboard impact, allow automatic employment, 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 Fleet and Force Protection FNC.

FY 2002 ACCOMPLISHMENTS:

Initiated:

- Development of technology for NGCM

Continued:

- Development of ATT component technology in propulsion, MicroElectroMechanical Systems (MEMS), and Guidance and Control (G&C).

FY 2003 PLANS:

Initiate:

- Transition of counter-torpedo technologies to Naval Sea Systems Command (NAVSEA) (PMS-415) Tripwire Torpedo Defense System (AN/WSQ-11) and Next Generation Countermeasure (NGCM).

Continue:

- Development of technology for NGCM.
- Continue development of ATT component technology in propulsion, MEMS, and G&C.

FY 2004 PLANS:

Continue:

- Development of technology for NGCM.
- Continue development of ATT component technology in propulsion, MEMS, and G&C.
- Transition of Next Generation Countermeasure (NGCM).

FY 2005 PLANS:

Continue:

- Development of technology for NGCM.
- Development of ATT component technology in propulsion, MEMS, and G&C.
- Transition of Next Generation Countermeasure (NGCM).

Congressional Plus-Ups:

	FY 02	FY 03
American Underpressure System (AUPS)	961	$0

Completed the test program of the AUPS including the control system design. In FY02 the project developed control simulation data to verify performance and safety of the system in order to fully respond to the United States Coast Guard stated requirements and permit rulemaking changes.

	FY 02	FY 03
Anti-Corrosion Modeling Software	0	1,223

Develop workable corrosion maintenance guidelines and criteria for high strength steel components, in particular arrestment gear of carrier aircraft. Present 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 aircraft corrosion with potential safety impacts and corrosion that is cosmetic.

	FY 02	FY 03
Battery Charging Technology	831	2,078

Provide applied research efforts to the development of improved battery charging technology that increases battery life 2-3 fold and reduces battery charging time. The battery charging technology will also detect impending battery failure to permit replacement prior to power loss. Application of this technology will prevent data loss, mission abort, and loss of life, as well as weight reduction for Marine Corps field units. This will also avoid the fleet failures of important Uninterruptible Power System (UPS) and starting systems that have left a couple of DDG51 class ships in the dark. FY 03 will focus on the development and application of algorithms for application to battery charging.

	FY 02	FY 03
Center for Advanced Power Systems (CAPS)	3,467	4,988

Development of a superconducting system research laboratory which includes development of the following major components: Superconducting Magnetic Energy Storage (SMES) Facility and High Temperature Superconducting Prototype Shipboard Transformer Research Facility. This laboratory will be used to simulate pulsed loads and to investigate future ultra-dense shipboard power system architectures. Development of a reconfigurable power conversion research

laboratory which includes procurement and development of programmable power converters and advance power system control structures. (FY02 Title was Center for Advanced Transportation Technology).

	FY 02	FY 03
Endeavor	961	3,325

Development of an integrated set of ship design tools including structural loading and hydrodynamic modeling tools.

	FY 02	FY 03
Fusion of Hyperspectral and Panchromatic Data	4,322	0

Conducted research to develop a real-time airborne fusion processor and algorithms for the Navy Hyperspectral/Imaging for Surveillance and Targeting (HISTAR) program. Established proposal for HISTAR. Research supported development of a hyperspectral 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.

	FY 02	FY 03
Data Fusion Processor	0	3,325

Apply advanced technology to a fusion processor. The effort develops a real-time airborne fusion processor and algorithms for the Navy Hyperspectral/Imaging for Surveillance and Targeting (HISTAR) program. Funding will support the development of a hyperspectral 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.

	FY 02	FY 03
Integrated Fuel Processor – Fuel Cell System	0	1,761

Develop a novel fuel processing system to reform the JP-5 fuel used for Naval aircraft. The fuel processor technology would be integrated into a turnkey fuel cell system, with payoffs of increased efficiency and lower emissions of auxiliary power units used on board aircraft and ocean-going vessels.

	FY 02	FY 03
Laser Welding and Cutting	0	1,956

Apply advanced technology to laser welding and cutting. The effort will provide development of laser based fabrication for application in Navy shipbuilding, including welding and cutting technologies. Laser based cutting and welding technologies could enhance shipyard productivity/automation, reduce costs, enhance ship performance/reliability/maintainability, and reduce weld-induced distortion/associated rework costs/ship signature. This technology could lead to low cost, higher quality production methods that would benefit U.S. shipyards.

	FY 02	FY 03
Miniature Autonomous Vehicles	0	977

Develop a distributed communication and control architecture for a cooperating multi-vehicle fleet of autonomous underwater vehicles (AUV). Control architecture will be validated by computer simulation and in-water prototype testing.

	FY 02	FY 03
Modular Advanced Composite Hull Form	1,445	977

Investigate hybrid (composite to steel) joints for application to hybrid ship hull and lifting body. The research explores joining concepts and develops experimental, theoretical, and analytical methods to assess their reliability under sea loads. The Hybrid Hull concept will facilitate the use of composites in Naval combatants to achieve stealth and survivability.

	FY 02	FY 03
Small Watercraft Demonstrator	0	4,156

Initiate development of a small watercraft with improved performance characteristics compared to existing small watercraft. Efforts focus 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 02	FY 03
Fiber Reinforced Polymer Composites Research	0	977

Identify key processing parameters that affect the variability of material properties in marine composite laminates. Develop models that predict mechanical design property as a function of these parameters. Link the material property results to a structural reliability analysis model for fiber reinforced composite panels.

	FY 02	FY 03

Three Dimensional Printing (3DP) Metal Working Technology	2,401	*

Provided applied research to the technique of three dimensional printing (3DP) metal working. The system incorporates a Three Dimensional Printing (3DP) machine and supporting process equipment. The project included working to define, develop and demonstrate the system and 3DP process on specific DOD and DLA applications. This project will advance the potential use of the 3DP process and its unique capabilities for the manufacture of components in an e-manufacturing environment. (*Appropriated in FY03 in PE 0602236N, $3,765)

	FY 02	FY 03
Unmanned Sea Surface Vehicle (USSV)	0	5,281

Initiate development of an advanced class of surface craft optimized for unmanned missions. The primary focus is 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 will also be explored.

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 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT:0602131M
PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Marine Corps Landing Force Technology	27,610	29,568	31,778	35,562	38,967	38,325	39,483	40,245

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 is organized into six amphibious expeditionary warfighting capability areas. These are: Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR); Maneuver; Logistics; Training and Education; Firepower; and Mine Countermeasures (MCM). The primary objective of this Program Element (PE) is to develop and demonstrate the technologies needed to meet the Marine Corps' unique responsibility for amphibious warfare and subsequent operations ashore. This PE provides the knowledge base to support Advanced Technology (6.3) and is the technology base for future amphibious/expeditionary warfare capabilities. This PE supports the concept based requirements 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). Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE. 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 Intelligence, Surveillance and Reconnaissance (ISR) key transformational capabilities within Sea Strike and the enhanced Sea-borne Positioning of Joint Assets within Sea Basing.

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	30,961	30,274	32,499	36,341
Adjustments from FY 2003 President's Budget:				
Execution Adjustment	-2,707			
Cong. Rescissions/Adjustments/Undist. Reduction	-150	-385		
SBIR Adjustment	-494			
NWCF Rate Adjustment			+12	-12
Pay Raise/Inflation Adjustments		-321	-733	-767
FY 2004/2005 PRESBUDG Submission:	27,610	29,568	31,778	35,562

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT:0602131M
PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology

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

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602131M Project Title: Marine Corps Landing Force Technology
PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Marine Corps Landing Force Technology	27,610	29,568	31,778	35,562	38,967	38,325	39,483	40,245

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 project is organized into six amphibious expeditionary warfighting capability areas. These are: Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR); Maneuver; Logistics; Training and Education; Firepower; and Mine Countermeasures (MCM). The primary objective of this project is to develop and demonstrate the technologies needed to meet the Marine Corps' unique responsibility for amphibious warfare and subsequent operations ashore. This project provides the knowledge base to support Advanced Technology (6.3) and is the technology base for future amphibious/expeditionary warfare capabilities. This project supports the concept based requirements 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). Due to the number of efforts in this project, the programs described herein are representative of the work included in this project. 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 Intelligence, Surveillance and Reconnaissance (ISR) key transformational capabilities within Sea Strike and the enhanced Sea-borne Positioning of Joint Assets within Sea Basing.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY02	FY03	FY04	FY05
Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR)	2,115	2,000	3,500	4,079

This activity provides technologies for secure, robust, self-forming, mobile communications networks; distributed computing to support information dissemination to all echelons; and sensors, software and data processing to support formation of appropriate common picture.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a
BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602131M Project Title: Marine Corps Landing Force Technology
PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology

FY 2002 ACCOMPLISHMENTS:

- Initiated high-density data storage (rugged, no moving parts) applied research program. Began developing chip manufacturing processes for the purpose of developing and testing prototype devices applicable to tactical systems.
- Completed Command and Control testbed for testing interoperability, usability and military suitability of developmental software and hardware.
- Continued Joint Tactical Radio System (JTRS) architecture and standards development work for transfer to the JTRS Joint Program Office. Selected Wideband Networking Waveform Standard Version 1.
- Completed wearable Very High Frequency/Ultra High Frequency vest antenna work (human effects/safety certification, ruggedness, prototype development) for transition to acquisition command.
- Completed development of a black and white, still-frame imaging capability with infrared payload for the Infantry Reconnaissance Round. Completed initial testing.
- Completed C4I gateway technology development effort to perform trade-off studies and tests of possible solutions for first entry communications reach back.
- Designed prototype for airborne command and control capability (moved to Budget Activity 3).

FY 2003 PLANS:

- Initiate development of low-probability of interception, low-probability of detection ultra-wide band communications technologies.
- Initiate development of network management capabilities for the low-bandwidth, heterogeneous communications environment.
- Initiate development of network security technologies for low-bandwidth distributed environments.
- Complete Joint Tactical Radio System Standards and Architecture development. Complete JTRS network modeling and methods of employment.
- Continue development of high-density, solid-state data storage devices.
- Initiate development of vehicular conformal antenna technology.

FY 2004 Plans:

- Complete development and testing of low-probability of interception, low-probability of detection ultra-wide band communications.
- Continue development of network management capabilities for the low-bandwidth, heterogeneous communications environment.
- Continue development of network security technologies for low-bandwidth distributed environments.
- Continue development of high-density, solid-state data storage devices.
- Continue development of vehicular conformal antenna technology.
- Initiate peer-to-peer communications networking technologies development.

- Initiate distributed tactical database management technologies development.
- Initiate development of information management technologies applicable to tactical decision systems.

FY 2005 Plans:

- Continue development of network management capabilities for the low-bandwidth, heterogeneous communications environment.
- Continue development of network security technologies for low-bandwidth distributed environments.
- Complete development of high-density, solid-state data storage devices.
- Complete peer-to-peer communications networking technologies development.
- Complete distributed tactical database management technologies development.
- Complete information management technology development.
- Initiate intelligent agent technology development for decision support and dynamic information management.
- Initiate development of agent-based course-of-action inference tools.
- Complete development of conformal vehicle antennas and evaluate.

	FY 02	FY 03	FY 04	FY 05
Maneuver	5,035	2,311	4,300	4,750

This activity develops technologies to support and enhance survivability and mobility of forces ashore including vehicles and systems.

FY 2002 ACCOMPLISHMENTS:

- Initiated Marine Corps Air Ground Task Force (MAGTF) Expeditionary Family of Fighting Vehicles (MEFFV) Phase I Lightweight Materials Development effort of structural armor concepts and materials with multifunctional capabilities.
- Continued MEFFV modeling and simulation (M&S) of an urban warfare scenario with capabilities from new armor materials and concept platforms.
- Initiated enhancements to third generation Concept Validation Model (CVM) of the Unmanned Ground Vehicle.
- Initiated development and design for Unmanned Ground Vehicle (UGV) technologies.
- Initiated Joint Spectrum Center (JSC) study for UGVs.
- Initiated UGV survivability analysis/database development.
- Initiated Reconnaissance Surveillance and Targeting Vehicle (RST-V) control system improvements including power budgeting and battery management electric transmission mode implementation.
- Completed RST-V Build #3 configuration through trade studies, design, and hardware and control development.
- Completed RST-V survivability testing and analysis.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a
BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602131M Project Title: Marine Corps Landing Force Technology
PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology

FY 2003 PLANS:

- Initiate MEFFV lethality study to drive science and technology investment.
- Begin MEFFV platform design and integration studies using modeling and design tools.
- Continue evolving the M&S tool development.
- Continue Lightweight Materials Development program, prepare for testing and down-selection process.
- Complete urban combat modeling runs over range of advanced vehicle concepts.

FY 2004 PLANS:

- Initiate Phase II of the MEFFV lightweight materials efforts to determine feasibility of scaling and producing candidate structural armor.
- Continue lethality analysis for the MEFFV and assess the commonality between the 10 ton and 30 ton MEFFV variants and technology trade-offs.
- Initiate the advanced combat vehicle propulsion design and development effort to investigate the trade-offs, technical feasibility and risk of advanced propulsion systems versus conventional propulsion systems.
- Initiate the concept design of a propulsion demonstrator platform (PDP) for use in assessing candidate propulsion systems and other technologies.
- Continue platform system design by applying Computer Aided Design (CAD) tools.

FY 2005 PLANS:

- Continue MEFFV design/development process and develop concept technologies in the area of mobility (propulsion) for assessment and evaluation.
- Initiate concepts and designs of the integrated MEFFV System utilizing the design tools developed in FY02 through FY04 and results of subsystem developments.
- Continue Phase II MEFFV Lightweight Materials efforts.
- Continue MEFFV development and fabrication of the PDP and associated analyses of integrating advanced propulsion technologies into the base system.
- Continue MEFFV lethality system analysis and select the design for integration into the PDP.
- Continue with Modeling and Simulation of detailed MEFFV concepts in accredited USMC and Joint Service scenarios.

	FY 02	FY 03	FY 04	FY 05
Logistics	1,370	1,600	2,100	2,600

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602131M Project Title: Marine Corps Landing Force Technology
PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology

This activity develops technologies to enhance movement of material to end users ashore with emphasis on packaging, maintenance, sensors and distribution. Additionally it develops technologies that enhance expeditionary power and water generation.

FY 2002 ACCOMPLISHMENTS:

- Completed Expeditionary packaging technologies for biodegradable and non-expendable materials for improved distribution/throughput of Sustainment items for Sea Based Logistics
- Initiated Rapid Deployable Composite Bridging Program
- Initiated Lightweight Power Generation (3kw) initiatives within Expeditionary Energy Program.
- Initiated advanced surface coatings and materials technologies to be utilized in Depot level Reliability, Availability, and Maintainability (RAM) and Service Life Improvement Programs.

FY 2003 PLANS:

- Complete Rapid Deployable Composite Bridging Program.
- Complete advanced surface coatings and materials technologies to be utilized in Depot level Reliability, Availability, and Maintainability (RAM) and Service Life Improvement Programs.
- Continue development of Lightweight (3kw) Power Generation via Micro Turbine Technologies. (Moved to Budget Activity 3)
- Initiated development of Alternative Power initiatives: Hybrid Zinc Air batteries and Fuel Cells.

FY 2004 PLANS:

- Initiate the development of water generation/purification and distribution program to demonstrate feasibility of performance improvement.
- Continue development of Alternative Power initiatives: Hybrid Zinc Air batteries and Fuel Cells.

FY 2005 PLANS:

- Continue the development of water generation/purification and distribution program to demonstrate feasibility of performance improvement.
- Continue development of Alternative Power initiatives: Hybrid Zinc Air batteries and Fuel Cells.

	FY 02	FY 03	FY 04	FY 05
TRAINING & EDUCATION	2,611	3,162	2,100	2,595

This activity develops advanced training technology and technologies that enhance neural and cognitive aspects of human performance including portable synthetic environment generation.

FY 2002 ACCOMPLISHMENTS:

- Completed evaluation of technologies available for the development of a Combat Service Support Element (CSSE) (Logistics) Tactical Decision-making Simulation (TDS). Developed a conceptual model for a TDS that will be used to supplement the program of instruction for the Logistics Officer's Course.
- Completed evaluation of potential technologies for the development of a Portable Synthetic Environment Generation capability. Developed a conceptual model for a system that will be capable of automatically producing a three dimensional synthetic database from a video stream of real world terrain and cultural features in a 'common' database format suitable for Close Quarter Battle (CQB) and Military Operations in Urban Terrain (MOUT) training.
- Completed assessment of the organizational and technological needs of the 4th Marine Expeditionary Brigade, Anti-Terrorism (4th MEB AT) and provided a final report for the Center For Emerging Threats and Opportunities.
- Initiated technology search and experimentation in the areas of combating terrorism and thermobaric weapons for the Center For Emerging Threats and Opportunities (CETO).

FY 2003 PLANS:

- Initiate evaluation of technologies available for the development of a Combating Terrorism (Cbt) Tactical Decision-making Simulation (TDS).
- Initiate development of technologies required to produce a prototype of a Combat Engineering Tactical Decision-making Simulation (TDS) to supplement the program of instruction for the Engineer Officer's Course.
- Initiate development of technologies required to produce a prototype of a Combat Service Support Element (CSSE) Tactical Decision-making Simulation (TDS) to supplement the program of instruction for the Logistics Officer's Course. Transition to higher level S&T (6.3) for product testing, evaluation, and demonstration.
- Initiate development of promising technologies for the development of a Rapid Portable Synthetic Environment Generation capability.
- Continue technology search and experimentation in the areas of combating terrorism, support for the 4th MEB AT, and thermobaric weapons for the Center For Emerging Threats and Opportunities (CETO)
- Initiate evaluation of technologies available for instrumentation and enhanced situational awareness in a Military Operations in Urban Terrain (MOUT) training environment.

FY 2004 PLANS:

- Continue development of technology to produce a prototype of a Combating Terrorism (Cbt) Tactical Decision-making Simulation (TDS).
- Initiate evaluation of technologies available for the development of Air Combat Element (ACE) and Command Element (CE) Tactical Decision-making Simulations (TDS).

- Evaluate candidate technologies available for the development of a Portable Synthetic Environment Generation capability.
- Develop and evaluate technologies available for instrumentation and enhanced situational awareness in a Military Operations in Urban Terrain (MOUT) training environment.
- Initiate development and evaluation of technologies available for the development of a Training Mission Support Center (TMSC).
- Initiate augmented cognition program to improve human cognition via multiple sensory modalities. This will provide improved human performance for complex cognitive tasks to include: reduced error rates; faster response times and enhanced task switching, especially under high stress.

FY 2005 PLANS:

- Continue to develop technologies available for the development of an Air Combat Element (ACE) and Command Element (CE) Tactical Decision-making Simulation (TDS).
- Initiate the development of a Rapid Portable Synthetic Environment Generation capability.
- Continue to develop and evaluate technologies available for instrumentation and enhanced situational awareness in a Military Operations in Urban Terrain (MOUT) training environment.
- Continue to develop and evaluate technologies available for the development of a Training Mission Support Center (TMSC).
- Continue Augmented Cognition/Enhanced Human Performance (Aug Cog) applied research efforts in the areas of human perception, memory, attention, focus and other neural warfighting attributes.

	FY 02	FY 03	FY 04	FY 05
Firepower	3,136	1,500	2,100	1,500

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

FY 2002 ACCOMPLISHMENTS:

- Initiated Tactical Weapons Control Station (TCS) software integration risk reduction in support of Dragon Warrior Unmanned Aerial Vehicle (UAV).
- Initiated assessment of micro-electro-mechanical systems (MEMS) technology developments for enabling possible integration into a targeting information system (TIS) to enhance firepower effects at ranges from near contact to 1-2 kilometers.
- Continued development of enhanced electro-optic signal processing and high performance, low cost uncooled Forward Looking Infra-Red (FLIR) for M1A1 Firepower Enhancement Program (FEP) technology insertion.

- Continued development of non-lethal weapons technology, e. g. neuro-muscular disruption (NMD) systems to deliver shock or trauma to multiple targets at greater than contact weapons ranges.

FY 2003 PLANS:

- Complete assessment of MEMS technologies for target information system (TIS) to enhance firepower effects.
- Complete TCS software risk reduction.
- Complete development of enhanced electro-optic signal processing and high performance, low cost uncooled FLIR in support of M1A1 FEP.
- Complete development of non-lethal NMD weapons technology for transition to Marine Corps Systems Command.

FY 2004 PLANS:

- Initiate development of technologies to improve far target location, extended range performance and detection of camouflaged/hidden targets in support of M1A1 FEP.
- Initiate concept development for a MEMS based TIS system.
- Initiate study of explosives technologies to improve firepower effectiveness while increasing affordability and decreasing logistical burden to Fleet Marine Force combat elements.

FY 2005 PLANS:

- Continue development of sensor technologies to improve firepower effectiveness while increasing affordability and decreasing logistical burden to Fleet Marine Force combat elements.
- Continue study of explosives technologies to improve firepower effectiveness while increasing affordability and decreasing logistical burden to Fleet Marine Force combat element.
- Complete concept development for a MEMS based TIS system.

	FY 02	FY 03	FY 04	FY 05
Mine Countermeasures (MCM)	N/A	1,350	2,609	3,000

This activity develops technologies to enable mine detection, neutralization, breaching and clearing from beach exit zone to the objectives.

FY 2002 ACCOMPLISHMENTS:

- Not applicable

FY 2003 PLANS:

- Initiate a tactically effective MCM capability program, which will become a functional component of Naval Expeditionary Maneuver Warfare (EMW).

- Initiate the evaluation of technologies relating to speed of detection (Stand-Off and Close-In), organic neutralization, assault breaching, tactical clearance, proofing, marking, and Command, Control, Communications, Computers and Intelligence (C4I) operations.

FY 2004 PLANS:

- Continue a tactically effective MCM capability program, which will become a functional component of Naval Expeditionary Maneuver Warfare (EMW).
- Continue Discovery and Invention (D&I) efforts to examine speed of detection (Stand-Off and Close-In), organic neutralization, assault breaching, tactical clearance, proofing, marking, and C4I operations. Examples of potential efforts include change detection, forward looking detection systems, unmanned ground vehicles with detection and marking capability, tailored explosives, advanced signature duplicators, and vehicle standoff neutralization systems.

FY 2005 PLANS:

- Continue a tactically effective MCM capability program, which will become a functional component of Naval Expeditionary Maneuver Warfare (EMW).
- Continue D&I efforts in the detection (Stand-Off and Close-In), organic neutralization, assault breaching, tactical clearance, proofing, marking, and C4I operations to identify transition to 6.3 Advanced Technology Development projects.

	FY 02	FY 03	FY 04	FY 05
Littoral Combat/Power Projection	13,343	17,645	15,069	17,038

This activity provides the capability for the demonstration and transition of technologies developed through the Marine Corps Science and Technology program.

FY 2002 ACCOMPLISHMENTS:

- Initiated study of surface craft maneuver in support of Ship to Objective Maneuver (STOM) in terms of communications needs, information needs, planning needs, and navigation needs.
- Initiated development of diver operated tactical hydrographic survey equipment for underwater reconnaissance capability.
- Initiated lethality effectiveness study and analyses of advanced kill mechanisms via analytic modeling and destructive testing.
- Initiated and released Broad Agency Announcement for technology development in the areas of Beyond Line of Sight communications, Intelligence, Surveillance and Reconnaissance (ISR) sensor packages, and maneuver planning.

- Obtained software programmable radios for use in demonstrations of secure wireless large area networks.

FY 2003 PLANS:

- Develop prototype Expeditionary Fires technologies to include platform and weapon stabilization techniques to enable firing on the move.
- Complete STOM study and architecture development. Implement technology roadmap recommendations.
- Complete development and demonstration of diver operated tactical hydrographic survey system. Transition to USMC Underwater Reconnaissance Capability program for acquisition.
- Complete lethality effectiveness study and provide results to USMC Expeditionary Fire Support System (EFSS) program.
- Award contract from Broad Agency Announcement (BAA) process for Advanced Amphibious Assault Vehicle (AAAV) obstacle avoidance system development and integration.
- Award contract from BAA process for Beyond Line of Sight (BLOS) tactical communications connectivity for use by maneuver forces.
- Initiate development of sensor technology packages for tactical platforms to include Electro-Optical/Infrared (EO/IR) and Chemical/Biological agent detection systems.
- Develop target acquisition technologies for achieving interoperability with US/Joint/Coalition close air support platforms.
- Develop, evolve and demonstrate 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.
- Initiate the development, integration and demonstration of an advanced Position Location Information (PLI) and range instrumentation system

FY 2004 PLANS:

- Continue development of planning and decision-making tools for Marine ground forces. Test the software and evaluate during training exercises.
- Complete the development of the PLI system and transition to the Multiple Integrated Laser Engagement System program.
- Continue development of BLOS tactical communications connectivity for use by maneuver forces.
- Continue development and integration of AAAV obstacle avoidance system.
- Continue development and integration of sensor technology packages for tactical platforms
- Initiate development of an architecture to network existing expeditionary fires systems.

FY 2005 PLANS:

- Continue development of planning and decision-making tools for Marine ground forces. Test the software and evaluate during training exercises.
- Demonstrate AAAV obstacle avoidance system and transition to acquisition.
- Demonstrate beyond line of sight tactical communications connectivity during a scheduled training exercise.
- Demonstrate and analyze data acquired by integrated sensor packages flown on tactical platforms.
- Complete target acquisition technologies for achieving interoperability with US/Joint/Coalition close air support platforms.
- Demonstrate a limited netted fires capability between systems.

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)

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BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602131M Project Title: Marine Corps Landing Force Technology
PROGRAM ELEMENT TITLE: Marine Corps Landing Force Technology

PE 0604808A (Landmine Warfare/Barrier Engineering Development)
PE 0602301E (Computing Systems and Communications Technology)
PE 0602702E (Tactical Technology)

D. ACQUISITION STRATEGY: Not applicable

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602232N
PROGRAM ELEMENT TITLE: C3 Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE
C3 Technology	0	1,368

This PE was restructured in FY 2002. FY 2003 Congressional Plus-ups appropriated in this PE are described under the following restructured program elements:

TITLE	PROGRAM ELEMENT	FY 2002	FY 2003
Common Sensor Module	0602235N	$0	$1,368

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602233N
PROGRAM ELEMENT TITLE: Human Systems Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE
Human Systems Technology	2,498	1,027

This PE was restructured in FY 2002. FY 2002 and 2003 Congressional Plus-ups appropriated in this PE are described under the following restructured program elements:

TITLE	PROGRAM ELEMENT	FY 2002	FY 2003
Maritime Fire Training/Barbers Point	0602236N	$2,498	$0
Bio-Detection Surveillance System	0602236N	$0	$1,027

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BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602234N
PROGRAM ELEMENT TITLE: Materials, Electronics & Computer Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE
Materials, Electronics, & Computer Technology	18,591	9,780

This PE was restructured in FY 2002. FY 2002 and 2003 Congressional Plus-ups appropriated in this PE are described under the following restructured program elements:

TITLE	PROGRAM ELEMENT	FY 2002	FY 2003
ADPICAS	0602236N	$1,251	
Advanced Fuel Additive	0602236N	$0*	$1,662
Anti-Corrosion Coatings	0602236N	$3,366	
Battlespace Information Display Tech Initiative Development Demo	0602235N		$2,055
Carbon Foam for Navy Applications	0602236N	$2,509	
Development of Magnetic Random Access Memory	0602271N	$ 966	
High Brightness Electron Source Program	0602271N	$1,442	
Innovative Communications Material	0602271N		$977
Materials Micronization Technology	0602236N	$3,379	
MicroArray Technology	0602271N	$3,366	
Printed Wiring Board Manufacturing	0602114N		$3,325
Silicon Carbide Semiconductor Material for Microwave Applications	0602271N	$1,346	
Thick Film Ferrite Magnetic Material	0602271N	$ 966	
Virtual Company Link	0602236N		$1,761

* $1,644 Appropriated in PE 0602236N in 2002.

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BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602235N
PROGRAM ELEMENT TITLE: Common Picture Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Common Picture Applied Research	122,933	148,222	59,022	70,120	82,545	87,503	77,142	78,598

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Common Picture Applied Research Technology Program addresses technology deficiencies associated with the Navy's Twenty-First Century Network Centric Warfare need for information as a resource and weapon. The focus is on a high performance network that achieves a common situational awareness to interconnect geographically distributed forces (surface, subsurface, air platforms and forward deployed forces) into a unified Naval Force. The program emphasizes the development of technology supporting real time planning and execution of Naval warfare missions ranging from land attack e.g., expeditionary and littoral warfare) to joint theater operations. Technology developments involve identifying and exploring technologies for the Fleet that: 1) provide desktop to desktop information services ashore and afloat; 2) support dynamic bandwidth and network management; 3) locate, extract and integrate critical, time sensitive information; 4) distribute information tailored to user needs; 5)provide a common, consistent understanding of the battlespace; 6) support interoperable secure networking among Naval, Joint, and Coalition forces. The goal is to provide decision-makers and warfighters with a robust, secure, mission responsive network; integrated information leading to 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. This program's technology developments directly support Future Naval Capabilities (FNCs) in Knowledge Superiority and Assurance (KSA), Missile Defense (MD), Littoral Anti-Submarine Warfare (LASW) and Fleet and Force Protection (FFP). Within the Naval Transformation Roadmap, this investment will technically enable the “Persistent Intelligence, Surveillance, and Reconnaissance,” “Time Sensitive Strike,” “Sea Based Information Operations,” and “Ship-to-Objective Maneuver” capabilities required by “Sea Strike;” and "Theater Air and Missile Defense" capability required by "Sea Shield".

Due to the number of efforts in this Program Element (PE), the initiatives described are representative of the work included in this PE.

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BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602235N
PROGRAM ELEMENT TITLE: Common Picture Applied Research

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	124,370	75,594	74,106	69,800
Adjustments from FY 2003 President’s Budget:				
Congressional Plus-Ups		76,000		
SBIR Reduction	-1,022			
Execution Adjustments	249			
Congressional Rescissions/Undistributed Reductions	-664	-1,764		
S&T Program Adjustments			-12,762	2,726
NWCF Rate Adjustments			-281	-11
Efficiencies at NWCF Activities			-400	-382
Pay Raise/Inflation Adjustments		-1,608	-1,641	-2,013
FY 2004/2005 President's Budget Submission:	122,933	148,222	59,022	70,120

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602235N Project Title: Common Picture Applied Research
PROGRAM ELEMENT TITLE: Common Picture Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Common Picture Applied Research	122,933	148,222	59,022	70,120	82,545	87,503	77,142	78,598

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project addresses technology deficiencies associated with the Navy's Twenty-First Century Network Centric Warfare need for information as a resource and weapon. The focus is on a high performance network that achieves a common situational awareness to interconnect geographically distributed forces (surface, subsurface, air platforms and forward deployed forces) into a unified Naval Force. The program emphasizes the development of technology supporting real time planning and execution of Naval warfare missions ranging from land attack (e.g., expeditionary and littoral warfare) to joint theater operations. Technology developments involve identifying and exploring technologies for the Fleet that: 1) provide desktop to desktop information services ashore and afloat; 2) support dynamic bandwidth and network management; 3) locate, extract and integrate critical, time sensitive information; 4) distribute information tailored to user needs; 5) provide a common, consistent understanding of the battlespace; 6) support interoperable secure networking among Naval, Joint, and Coalition forces. The goal is to provide decision-makers and warfighters with a robust, secure, mission responsive network; integrated information leading to 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. This project's technology developments directly support Future Naval Capabilities (FNCs) in Knowledge Superiority and Assurance (KSA), Missile Defense (MD), Littoral Anti-Submarine Warfare (LASW) and Fleet and Force Protection (FFP). Within the Naval Transformation Roadmap, this investment will technically enable the "Persistent Intelligence, Surveillance, and Reconnaissance," "Time Sensitive Strike," "Sea Based Information Operations," and "Ship-to-Objective Maneuver" capabilities required by "Sea Strike"; and "Theater Air and Missile Defense" capability required by "Sea Shield".

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Knowledge Superiority and Assurance	26,000	25,899	18,529	17,226

KNOWLEDGE SUPERIORITY AND ASSURANCE: This activity explores the underpinning technologies that enable network-centric operations, including the FORCEnet concept for Naval warfare. The approach involves technology exploration and development focus areas: 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. This effort will further enhance the Navy's capability to exploit, manage and integrate complex, heterogeneous, multi-source information for the next generation common picture. Dynamically Managed, Interoperable, High-Capacity Connectivity addresses wireless network technology critical to the performance and robustness of Naval communications for air, ship, submarine and land platforms. This will enhance Naval communications with 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. This effort will enable knowledge-based threat assessment and rapid response for emergent, time-critical events.

FY 2002 Accomplishments:
The Intelligent Marine Multi-Agent Command and Control System demonstrated improved interoperability and enhanced situational awareness to the individual warfighter through object-oriented and agent-based information architecture. The Real-Time Execution Decision System explored automated methods for monitoring, assessing, and evaluating threats to enhance a Carrier Battle Group staff's capability to respond in real-time to a dynamically changing battlespace environment, enabling airborne assets to attack time-sensitive targets. The Multi-National Virtual Operation Network demonstrated tactical and operational improvements in the timely exchange of information between United States and Allied/Coalition forces through the use of virtual private networks and secure web servers. The Cryptologic Management and Analysis Support System (CMASS) continued development of automated Indications and Warnings (I&W) tactical decision aids permitting an analyst to process large amounts of data in a short period of time. This initiative directly supports on-board platform data processing. The Environmental Visualization effort provided improved forecasting algorithms for existing Navy meteorological systems supporting strike operations in near real time.

This activity also pursued: (1) Knowledge Web Technologies to improve commanders' situational awareness by organizing and displaying web-based information from multiple warfare domain data sources; (2) Human Alerting and Interruption Logistics to improve watchstanders' performance and decision making through techniques that optimize performance when confronted with large amounts of data (attention management); (3) Efforts to develop middleware for the Defense Information Infrastructure (DII) and Common Operating Environment (COE) command and control systems with other naval systems that will improve interoperability between submarine tactical sensors; and (4) The Extensible Tactical Command, Control, Communications, Computers and Intelligence (C4I) Framework (XCTF) to increase speed of command through integration of multiple data sources.

FY 2003 Plans:
Continue CMASS algorithm development for I&W, including automatic recognition of reportable events and automatic generation of routine periodic reports. Continue refinement of the Environmental Visualization forecasting algorithms. Refine the Knowledge Web Technologies by expanding the integration of information from multiple sources. Refine the middleware for the DIICOE to improve interoperability in theater by enabling users to share contact information, overlays, fleet message information and displays. Continue Human Alerting and Interruption

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Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602235N Project Title: Common
PROGRAM ELEMENT TITLE: Common Picture Applied Research Picture Applied Research

Logistics through additional algorithms to assist in data management. XCTF will refine its efforts to develop an extensible data management framework to enable stove piped 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. Other efforts will continue improving mission planning cycles by developing algorithms and tools that guide staffs through doctrine-based planning and 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 will initiate 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 one place in which to store intercept data, automatic operator alerting, and voice analysis. An operational test for CMASS is planned. Continue Environmental Visualization forecasting algorithms by providing information less than an hour old for strike operations. Conduct at sea tests in XCTF 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. Knowledge Web Technologies will continue refinement and conduct demonstrations of the tools and procedures. The Analytic Support Architecture will be continued and refined to improve location accuracy for air defense threats. The Underwater Surveillance Data-Link Network will refine its algorithms and conduct a demonstration of its capabilities.

FY 2005 Plans:
Continue demonstrations of CMASS. Extend Environmental Visualization capabilities to large deck amphibious assault ships to support meteorological products for multiple users in support of strike operations. Continue 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 the techniques for data management in XCTF to fuse heterogeneous data from multiple sources.

Other efforts will focus on integration and information sharing across component commands, tactical units, coalition forces, and non-governmental agencies by means of web-based crisis information management techniques, visualization capabilities, and group planning tools. In addition, this activity will explore rapid course of action development by means of synthetic semi-automated forces for fast, large-scale, high-fidelity simulations, including models of human cognition and visualization techniques for assessment of outcomes and uncertainties.

	FY 02	FY 03	FY 04	FY 05
Platform Awareness and Protection Electronic	1,600	2,000	2,000	2,000

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BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602235N Project Title: Common Picture Applied Research
PROGRAM ELEMENT TITLE: Common Picture Applied Research

PLATFORM AWARENESS AND PROTECTION/ ELECTRONIC WARFARE (EW) SYSTEMS: This activity supports the Fleet and Force Protection (FFP) Future Naval Capability (FNC). Current small platforms (both surface and airborne) have little to no situation awareness (SA) or self-protection against threat missile systems. This activity focuses on closing that gap by developing technologies that can provide these platforms the capability to achieve very accurate hemispheric direction finding (DF) of radio frequency (RF) signals to deny the enemy their effective use, or to exploit their weaknesses. This capability, when integrated with emitter identification and Low Probability of Intercept (LPI) radar detection systems, provides netted targeting information and cueing that allows for platform self-protection against various threat systems.

FY 2002 Accomplishments:
The Personal Communications Systems (PCS) Exploitation effort performed laboratory tests and continued integration and testing of optimized jamming techniques into the EA-6B aircraft. The Tactical Reactive Command and Control Warfare (C^2W)/Electronic Attack (EA) Network effort developed decentralized jammer resource management software that supports a heterogeneous mix of EA platforms. The Battlefield Ordnance Network Centric Employment (BONCE) effort developed a motion compensation algorithm. The Adaptive Mixed-Mode Very Large Scale Integration (VLSI) Sensors for Micro Air Vehicles (MAV) effort included scheduling of the final demonstration of sensors. Under the Electronic Warfare Integrated Systems for Small Platforms (EWISSP) effort the platforms' Concept of Employment (COE) was reviewed and trade-offs conducted, which led to the definition of performance requirements for an affordable EW System capable of providing substantially increased platform survivability.

FY 2003 Plans:
Evaluate data compression and transmission schemes and complete development of the detection algorithm framework and real-time processor under the BONCE effort. Analyze and optimize hardware for the proof-of-concept demonstration and identify concept performance and enabling technology factors under the Tactical Reactive C2W/EA Network effort. The EWISSP effort will perform Shipboard Laser Acquisition System (SBLAS) 90-degree system design studies and explore concepts for an optical slip ring for a two-piece flexible countermeasure mast.

FY 2004 Plans:
The BONCE effort will conduct laboratory performance explorations of a lightweight electro-optic/infrared (EO/IR) subsystem in preparation for Unmanned Aerial Vehicle (UAV) employment. The EWISSP effort will explore and develop subsystem for the 90-degree SBLAS system and a countermeasure system.

FY 2005 Plans:
Continue exploration and refinement of the subsystem interface software for the EWISSP effort.

	FY 02	FY 03	FY 04	FY 05
Multi-Source Integration and Combat Identification	8,200	7,900	6,986	7,175

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BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602235N Project Title: Common Picture Applied Research
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MULTI-SOURCE INTEGRATION (MSI) AND COMBAT IDENTIFICATION (CID): This activity supports the Missile Defense Future Naval Capabilities (FNC). Efforts focus on development of technology that addresses 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. Projects under this activity are the Affordable Ground Based Radar; Multi-Source Integration effort that reduces decision and response time, improves battlespace awareness and increases combat system efficiency and responsiveness; the Advanced Sensor Networking Technology (ASNT) that supports cooperative engagement capabilities; and the Composite Combat Identification (CCID) effort for missile defense that will build combat identification (CID) on air contacts using track attributes from real- and non-real time data.

FY 2002 Accomplishments:
This activity continued development of risk reduction technology for the Affordable Ground Based Radar (AGBR). This multi-mode, multi-functional radar is being developed on an accelerated schedule for USMC, which needs an advanced multi-functional mobile radar capability for Expeditionary Littoral operations. (This effort moved to PE 0603271N in FY 2003.) MSI efforts continued to improve E-2C aircraft situational awareness and reduce risk. To further develop the E-2C MSI technology, the activity investigated satellite communication (SATCOM) Electronic Surveillance Measures (ESM) correlation algorithms. The Advanced Sensor Networking Technology (ASNT) was initiated to enable Cooperative Engagement Capability (CEC) to integrate Electronic Surveillance (ES) sensors. The Composite Combat Identification effort developed algorithms for correlation of real-time track files from CEC with signals intelligence data in the EP-3E reconnaissance aircraft and Ship Signal Exploitation Equipment (SSEE) in surface ships. It also began development of a common reasoning algorithm for high confidence CID to be demonstrated in the naval open architecture combat system.

FY 2003 Plans:
The MSI activity will continue developing algorithms to integrate radio frequency (RF) Sensors, Identification Friend or Foe (IFF), and Joint Tactical Information Distribution System (JTIDS) to SATCOM data. In the ASNT project, the goals are to design and develop algorithms for ES data association and CEC track correlation. The CCID project will continue development of algorithms to correlate and fuse CEC data with ISR data processed aboard EP-3E aircraft and SSEE-equipped surface ships, as well as develop an advanced CID common reasoning algorithm for the naval open architecture combat system.

FY 2004 Plans:
The MSI activity will continue developing and testing algorithms to integrate RF Sensors, IFF, and JTIDS to SATCOM Electronic Intelligence data broadcasts. The ASNT project will continue development advanced algorithms for integration of ES data into the CEC program. The CCID activity will complete development of algorithms to correlate and fuse CEC data with ISR data processed onboard EP-3E aircraft and continue these effort for SSEE-equipped surface ships. It will also continue development of an advanced common reasoning algorithm for the naval open architecture combat system.

FY 2005 Plans:
The MSI activity will continue algorithm development efforts that integration of RF Sensors, IFF, CEC and JTIDS to SATCOM Electronic Intelligence data broadcasts in the E-2C aircraft and begin efforts to apply these algorithms to other platforms, including the naval open architecture combat system. The ASNT project will continue development of advanced algorithms for integration of ES data into the CEC program. For CCID, the effort will conduct subsystem integration and systems integration laboratory testing of common reasoning algorithm, while continuing to develop algorithms to correlate and fuse CEC data with ISR data processed onboard SSEE-equipped surface ships.

	FY 02	FY 03	FY 04	FY 05
Communication and Networks	10,782	10,000	8,000	14,611

COMMUNICATIONS AND NETWORKS: This activity supports developing wireless communications network technologies that are critical to the performance and robustness of Naval communications for air, ship, submarine, and land platforms which is critical for network centric operations. Technology 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 benefit of this exploration includes increased network data rates, improved coalition interoperability, dynamic bandwidth management, greater mobile network connectivity, and efficient waveforms to improve communications with land forces.

FY 2002 Accomplishments:
The reliable Multicast Dissemination Protocol transitioned into the Submarine Information Screening and Delivery System and the United States Postal Service, increasing network throughput and reliability. The Optimum Link State Routing (OLSR) protocol for networking and mobility management over heterogeneous networks was developed and simulated, providing increased network connectivity in a mobile environment; field testing of OLSR protocol was performed over a wireless network with several mobile nodes. Dynamic access for satellite bandwidth management underwent initial development and testing in Fleet Battle Experiment India using remote control features of commercial modems, increasing the efficient use of available satellite bandwidth. A demonstration architecture was defined for interoperable networks in a coalition environment involving seven other nations under the international Memorandum of Understanding effort, Interoperable Networks for Secure Communication (INSC). Tactical phased array networking and scheduling algorithms were developed in support of a mobile airborne net to increase the connectivity capacity of airborne platforms using directional, steered phased array antennas for connectivity. Additional progress included design of a new digital receiver architecture and components, including a cross-correlator, that reduce interference. The activity developed a bandwidth efficient waveform using turbo coding and continuous phase modulation (anticipated 100 Kbps data rate over 25 KHz bandwidth) that will result in

approximately a 4:1 improvement in data rate efficiency. The design features adaptive equalization for a Line-of-Sight (LOS) channel with application to the Joint Tactical Radio System (JTRS) and the ARC-210 radio.

FY 2003 Plans:
The activity will develop the Dynamic Backbone Subnet networking protocol suite for mobility management of heterogeneous networks; integrate it with an IEEE 802.11 Wireless Local Area Network (WLAN) device; and field test it in a small, mobile network to determine if there is improved Low Probability of Intercept/Low Probability of Detection for remote users. A dynamic access controller prototype for bandwidth management will also be developed, adapted to Naval satellite channels, and field tested. The INSC effort will include a multinational demonstration of interoperable networks in a coalition environment, including mobility, routing, security, and network management with various application services. Other plans include development of 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. Digital receiver components will be fabricated and tested. Software for a bandwidth efficient waveform (with advanced modulation, coding, and adaptive equalization) will be developed, designed and implemented into prototype modem. A medium access control algorithm to allow multiple submarines to share a single satellite communications channel will be developed, and its performance will be simulated. Planned WLAN development includes integration of low probability of intercept/detection technology with a WLAN to provide wireless network access devices for vulnerable assets. Other near term plans include the design of an optical, tunable, microwave filter for multifunction antennas.

FY 2004 Plans:
The activity will continue experimenting and sharing results from multinational demonstrations of interoperable networks in a coalition environment. Also, an INSC symposium for dissemination and presentation of contributions from each of the memorandum of understanding between the nations will be organized. Field tests will be conducted of the tactical phased array networking and scheduling algorithms, using a small set of mobile platforms and phased arrays. The digital receiver front-end will be integrated on cryocooler for a demonstration of the superconductive digital receiver. This JTRS-compliant receiver (software programmable) can be used to mitigate several classes of cosite interference problems. A prototype modem will be tested over 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. Additionally, the LPI/D technology will be integrated with a secure Wireless Local Area Network (LAN) 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. Other plans call for evaluating and developing solutions to next generation IP technology to meet Navy/Marine Corps networking challenges particularly mission responsive quality of service; and developing options for addressing existing problems through enhanced capabilities of Internet Protocol (IP) version 6 (IPv6) technology.

FY 2005 Plans:
The activity will continue testing of the next generation IP software solutions and options within Navy, DoD, and coalition networking test beds; investigation of IPv6 and IPv4 network coexistence strategies; and provision of IPv6 technology solutions into USN/USMC IP architectures.

	FY 02	FY 03	FY 04	FY 05
Network Command, Control and Combat Systems	24,500	22,600	18,007	23,617

NETWORKED COMMAND, CONTROL & COMBAT SYSTEMS: This activity area supports FORCEnet and network centric operations through the exploratory development of advanced technologies that contribute to integrated decision-making and mission execution to achieve battlespace superiority. This requires a Common Tactical Picture that is consistent and traceable to the Common Operational Picture. To achieve this, warfighters require: a network infrastructure to accommodate concurrent integrated and parallel processing, an information grid, situation awareness geared toward a user's requirements, self-synchronization, and enhanced speed of command. Efforts to provide advanced high-speed inter theater sealift configurations, in particular projects to mature friction drag reduction concepts will be explored. Overall, the technologies in this activity should enable warfighters to leverage the power of networks to exploit information and information technology as well as maximize the capability of platforms to use information to accomplish missions. The technologies should provide a force multiplier effect and support 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, which provides improved battlespace views including augmented virtual reality; (4) battlespace decision aids, which assist with optimized planning, assessing, executing, and monitoring military operations; (5) networked command and control (C2) for combat applications, which supports 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.). Efforts in each area emphasize leading edge concept exploration to support the Navy's vision of Network Centric Warfare.

FY 2002 Accomplishments:
Algorithms were developed to exploit the epipolar structure of a scene from multiple views on tactical imagery efforts. Significant informational features were extracted from video imagery using the Helmholtz Principle and image enhancement proof-of-concept techniques tools which have been adopted by joint imagery systems. The Battlefield Augmented Reality effort developed a metatracker algorithm that switches between multiple sensor inputs. In addition, the effort designed and fabricated a mobile 6 Degrees of Freedom (DOF) high precision virtual reality tracker. Also during FY 2002, the Combat Systems Technology effort demonstrated the missile deconfliction process within the AEGIS High Performance-Demonstration (HiPer-D) environment. An algorithm, prototyped in the HiPer-D environment, was run in real time to assess best shooter based on executable actions and current state of

platform resource allocations and schedules. The Real Time Deconfliction effort evaluated a four-dimensional airspace deconfliction algorithm for AEGIS surface-to-air (SAM) scheduling. The Theater Battlespace Command & Control effort tested three different C2 architectures to include a Common Object Request Broker (CORBA) agent, autonomous agents, and web services integration. This activity designed algorithms to support the Distributed Real-Time Combat Systems (DRCS), an effort focused on delivering real-time signals intelligence (SIGINT) and sensor data to Special Operations Forces (SOF) that usually have constrained devices and transmission bandwidths. The effort developed a static distributed real-time object-oriented database replication algorithm called Just-In-Time Real Time Replication (JITRTR) that generates replication transactions that copy required data where and when it is needed. The algorithms were tested operationally with SOF. The effort also used a dynamic schedulability analysis to ensure that the deadlines of the replication transactions are met.

FY 2003 Plans:
The multi-resolution, multi-scale image registration work continues to address issues in multi-sensor, multi-modal, multi-channel image registration/coordination with applications to precision targeting, image enhancement, change detection and fusion. Techniques that are contrast invariant, automatic, and take into account three-dimensional projective transformations from two dimensional images. Visualization technology plans also include applying computer graphics algorithms to visualize uncertainty for underwater environmental and target data. Real Time Deconfliction effort plans include pre-launch flyout deconfliction. In addition, information network situational awareness plans are to build towards a Common Relevant Operational Picture of the extended Information Battlespace, especially focused on Information Assurance issues. For DRCS, the activity will extend the concepts of the 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. New algorithms will use an initial estimate of data access requirements to determine when and where to create replicas of the real-time data. The new algorithms will produce replication transactions that make copies of time-critical data in locations where the data will be needed. The DRCS effort will also conduct a limited objective experiment with SOF operators to collect valuable operational information needed to develop the algorithms.

FY 2004 Plans:
Multiresolution and Multiscale Image Processing effort plans include multi-modal image registration. Plans in visualization technology include leveraging Naval Research Laboratory (NRL) Virtual Reality Workbench and Software from NRL and Virginia Tech. Real Time Deconfliction effort plans include real-time operator controls. The Theater Battlespace Command & Control effort plans involve experimentation in comparing all three alternative architectures. The activity will design Quality of Service (QoS) real-time model which 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. New techniques for providing improved computer network defense and improved situational awareness are planned. The real time data replication effort will conduct laboratory demonstrations of distributed real-time networked data element replication and conduct cross database comparisons. Other efforts include advanced algorithm development and software tools and decision aids to handle and process large volumes of information.

FY 2005 Plans:
Multiresolution and Multiscale Image Processing effort plans include image registration error analysis. Plans in visualization technology include performing an evaluation to determine the value of 3D techniques. Real Time Deconfliction effort plans include worst-case detection and conflict avoidance. Plans for the Battlefield Augmented Reality System effort include augmenting the real world with computer-generated information. 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 02	FY 03	FY 04	FY 05
Human Computer Interface	9,573	5,500	5,500	5,491

HUMAN COMPUTER INTERFACE: This activity focuses on improving platform, task force and battle group operations by developing human-centric decision support technology for incorporation into operational systems. The general objectives of the area 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 with the effect of creating decision-action cycles faster than an enemy's and reducing 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 2002 Accomplishments:
As part of the Command 21 effort, a Knowledge Web and Knowledge Desks were installed in the Tactical Flag Command Center aboard the USS Carl Vinson for use by Commander Carrier Group Three. These decision support systems were used successfully during Operation Enduring Freedom, significantly improving speed of command and collaboration among battle group staff members. Mathematical optimization models that provided support for the Chief of Naval Operations (CNO) Strategic Studies Group on FORCEnet were developed and used to evaluate potential enhancement of command and control team performance in a network-centric environment. In addition, cognitive-based intelligent agent support was developed for aircrew interface with automated subsystems, to improve pilot situational awareness and improve performance under conditions of information overload. Under this effort multinational decision support data and tools were developed for Pacific Command (PACOM) use in the Joint Planning and Execution Community (JPEC). Audio alerting techniques were developed for the Helicopter Aircrew Integrated Life Support Systems (HAIL-SS). New usability engineering processes and principles were produced for virtual environments for complex military software systems. These processes and principles form the foundation for the process of usability engineering for virtual

environments across commercial, military, and other organizations. Visualization tools were developed that make it easier to identify recurrent patterns of information sharing and management.

FY 2003 Plans:
Use influence nets and discrete event models to support Effects-Based Operations during exercises at Joint Forces Command, the Naval War College, and the Joint Warfare Analysis Center. Optimization algorithms will be developed for command and control applications to enhance execution monitoring and dynamic replanning of Naval tactical missions. Computational models will be developed for joint intelligence analysis, as well as shared virtual surfaces for quick-reaction team decision-making. In the near term, development and testing is planned of advanced audio technology and interactive audio management user interfaces for multi-modal tactical workstations. In addition, a model will be developed to describe human-automation interactions with respect to information integration in real-time critical decision-making problems. In addition, simulated devices will be developed for the study of interface design with isomorphic interface control, that is, the ability to swap interface features in and out.

FY 2004 Plans:
Priorities include the development of 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 is expected to provide computational formalisms for the design of adaptive architectures for command and control. Coalition teams will benefit from user/agent interfaces for knowledge sharing, and command and control improvements will stem from the development of cognitive models for agent-assisted asynchronous collaboration. Further research is planned to create a generalized template for human-automation interaction for insertion into Naval applications and for development of interface designs that incorporate advanced audio components into multiple task, high-tempo environments. In addition, construction of isomorphic interface controls for three simulated devices will enable the systematic manipulation of the perceptual-motor and cognitive effort required to use each device — essentially creating a cost effective method of simulating human learning and avoiding expensive human testing.

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FY 2005 Plans:
Development efforts include model-based simulations and experiments that will be conducted to investigate the effectiveness of hierarchical organizational structures in network-centric operational environments in order to evaluate the implementation of FORCEnet concepts. Exploration will continue into reconfigurable organization design structures for culturally diverse decision-making teams; video scene enhancement tools for improved situational awareness; improved designs for integration of audio into Naval applications; and improving the interface designs of simulated devices by comparing the performance of simulated human users with real users in acquisition of knowledge and performance ability.

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CONGRESSIONAL PLUS UPS:

	FY 02	FY 03
Battlespace Information Display Technology	2,020	*0

*$2,055 (Appropriated in PE 0602234N in FY03).

BATTLESPACE INFORMATION DISPLAY TECHNOLOGY: The Dominant Battlespace Command effort established a state-of-the-art battlespace visualization environment to advance Joint Vision 2020 objectives and the United States Navy's "Forward from the Sea" strategy. Dominant Battlespace Command integrates commercial technologies with emerging Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) capabilities, specifically for Navy and Marine Corps battlefield commanders and their staffs. In the absence of proven data correlation and information fusion algorithms, Dominant Battlespace Command visually represented the positions and tracks of ships, aircraft, and ground-based units, along with threat envelopes - in a whole earth, scalable, multi-resolution virtual display linked to intelligence and operational databases. Therefore, Dominant Battlespace Command presented the commander with the battlespace that closely approximates what one sees in their "mind's eye." This realization of the mind's-eye view is expected to result in intuitive actions that transform the 2-D battlespace into a 4-D battlespace so that the warfighter can view events in near-real time and fold in operational aspects associated with time - the 4^{th} dimension. In 2002, demonstrated a Dominate Battlespace Command prototype system enhanced with the capability to visualize the common undersea picture during Fleet Battle Experiment Juliet (FBE-J). Additionally, conducted experiments to collect user information from the Navy, Army, Air Force and US Forces Central Command.

	FY 02	FY 03
Common Sensor Module	1,927	*0

*$1,368 (Appropriated in PE 0602232N in FY 03)

COMMON SENSOR MODULE:

FY 2002 Accomplishments: Developed of small common sensor modules for ground forces and conduct limited demonstrations.

FY 2003 Plans: 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 resulting module will be designed as a universal unattended sensor package to meet both USMC and USSOCOM mission needs.

	FY 02	FY 03
Research In Augmented And Virtual Environment Systems (RAVES):	0	2,444

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PROGRAM ELEMENT TITLE: Common Picture Applied Research Picture Applied Research

RESEARCH IN AUGMENTED AND VIRTUAL ENVIRONMENT SYSTEMS (RAVES): Develop innovative software, hardware, and prototyping methods for producing effective and robust virtual and augmented reality systems for military applications. Develop 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. Strategies for integrating disparate augmented and virtual environments and scenario generation and after action review tools will be developed. Algorithms and systems will be 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, will be developed and demonstrated. Evaluation and usability studies will be 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 MOUT facilities.

	FY 02	FY 03
Naval Automation and Info Management Tech	0	2,444

NAVAL AUTOMATION AND INFORMATION MANAGEMENT TECHNOLOGY: Reduce the risk associated with advanced IT for information handling and management in support of Expeditionary Warfare by allowing operators to evaluate new technology in operational situations. Efforts for this program include participation in a Joint Forces Command/ II MEF exercise, evaluating key next-generation IT applications and linkages.

	FY 02	FY 03
National Center for Advanced Secure Systems Research (NCASSR)	0	5,623

NATIONAL CENTER FOR ADVANCED SECURE SYSTEMS RESEARCH (NCASSR): Develop an information centric (content-based) approach to security that meets the needs of tactical mobile forces operating in a network centric coalition warfare environment. It will address 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, financial and medical information protection.

	FY 02	FY 03
Submarine Enabling Airborne Data Exchange and Enhancement Program	0	1,467

SUBMARINE ENABLING AIRBORNE DATA EXCHANGE AND ENHANCEMENT PROGRAM: Support technologies that facilitate timely exchange of tactical data between airborne and submarine platforms.

	FY 02	FY 03
Modular Command Center	0	12,470

MODULAR COMMAND CENTER: Develop and demonstrate 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 will develop and demonstrate (1) Mobile Modular Command Center (M2C2) leveraging facilities in the Mid-Pacific (MIDPAC) region; (2) Cooperative Engagement Capability (CEC) antenna for Advance Hawkeye; (3) Long Range Theater Ballistic Missile Defense (TBMD) Surveillance at PMRF. The M2C2 will use 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 will leverage commercial off-the-shelf hardware for modular implementation.

	FY 02	FY 03
Tactical Component Network	34,190	29,093

TACTICAL COMPONENT NETWORK (TCN) Demonstration: Integrate Tactical Component Network (TCN) at the Pacific Missile Range Facility (PMRF) to support networking for the Navy's cooperative engagement capability demonstrations. Develop integrated modular command posts for various sites at PMRF and integrate both the range sensors with advanced sensors in development using TCN software. This effort includes three tasks: 1) integration of TCN network capability at PMRF and use 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); 3) assist 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 02	FY 03
Theater Undersea Warfare (TUSW) Initiative	4,141	8,312

THEATER UNDERSEA WARFARE (TUSW) INITIATIVE: Using Web Centric ASW as the backbone technology, TUSW will work with the Maui High Performance Computing Center and PMRF to integrate the undersea picture to the single integrated picture.

	FY 02	FY 03
UESA	*0	12,470

*$16,320 (Appropriated in PE 0204152N in FY 02)
UESA: Develop and demonstrate 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), and follow-on flight tests in an appropriate aircraft. Work will include establishing a Radar Test Bed at PMRF.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:

PE 0601153N (Defense Research Sciences)
PE 0204152N (E-2 Squadrons)
PE 0206313M (Marine Corps Communications Systems)
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 (Marine Corps Advanced Technology Demonstrations)
PE 0604307N (Surface Combatant Combat Systems Engineering)
PE 0604518N (Combat Information Center Conversion)
PE 0205601N (HARM Improvement)

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

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BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602236N
PROGRAM ELEMENT TITLE: Warfighter Sustainment Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Warfighter Sustainment Applied Research	107,343	106,745	52,213	59,157	64,832	55,253	56,457	57,703

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This PE funds applied research supporting FNCs (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, personnel, and human factors (HF); naval systems training; expeditionary logistics distribution and command/control; littoral combat and power projection capabilities; energy conversion; advanced naval materials; medical technologies; environmental quality, and biocentric technologies. Within the Naval Transformation Roadmap, this investment supports eight transformational capabilities within the "Sea Strike", "Sea Shield", and "Sea Basing" operational concepts. Additionally, this PE provides technologies to protect the critical "Sea Warrior" component of the overarching "FORCEnet" operating architecture and supports the "Sea Enterprise" transformation process to maximize Naval business efficiencies.

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

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	107,842	68,852	68,636	69,226
Adjustments from FY 2003 President’s Budget:				
Congressional Adds		40,310		
Cong, Rescissions/Adjustments/Undist. Reductions	-524	-1,259		
Execution Adjustments	1,629			
NWCF Rate Adjustments			-153	51
Efficiencies at NWCF Activities			-347	-362
S&T Program Adjustments			-14,857	8,483
Pay Raise/Inflation Adjustments		-1,158	-1,066	-1,275
SBIR Reduction	-1,604			
FY 2004/2005 President’s Budget Submission:	107,343	106,745	52,213	59,157

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602236N
PROGRAM ELEMENT TITLE: Warfighter Sustainment Applied Research

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical: Not Applicable.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602236N Project Title: Warfighter Sustainment Applied Research
PROGRAM ELEMENT TITLE: Warfighter Sustainment Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Warfighter Sustainment Applied Research	107,343	106,745	52,213	59,157	64,832	55,253	56,457	57,703

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project funds applied research supporting FNCs (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, personnel, and human factors (HF); naval systems training; expeditionary logistics distribution and command/control; littoral combat and power projection capabilities; energy conversion; advanced naval materials; medical technologies; environmental quality, and biocentric technologies. Within the Naval Transformation Roadmap, this investment supports eight transformational capabilities within the "Sea Strike", "Sea Shield", and "Sea Basing" operational concepts. Additionally, this project provides technologies to protect the critical "Sea Warrior" component of the overarching "FORCEnet" operating architecture and supports the "Sea Enterprise" transformation process to maximize Naval business efficiencies.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Manpower, Personnel and Human Factors	6,854	6,605	4,867	3,691

These technologies enhance the Navy's ability to select, assign, and manage its people. Technology developments in these areas respond 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 2002 ACCOMPLISHMENTS

- **Whole Person Assessment**

Initiated:

- Began the pre-test of all instruments for the person-organization fit effort. This work will develop and test all models and indices for assessing the degree of fit between the person and the organization.
- Commenced the selection of specific predictor measures and objective presentation for the psychometrics of measures program that help "tease out" important non-cognitive individual differences (social judgment/intelligence, emotional intelligence, tendency for negative outlook, coping skills, etc.) useful in making career decisions.
- Initiated the models of aptitude and interest effort to analyze data for job interest inventory. Verified and extended model through correlational and structural techniques to be used in a flexible and valid selection/classification system.
- Started effort that focuses on development of algorithms that optimally assign individuals to jobs. Deliver software version 1.0 from this Usability and Contents research program.

Completed:

- Completed the biopsychological investigation of relationships among performance on spatial abilities (human ability to reason about visual events in space), tests, and performance during stressful training. This could result in significant cost savings in predicting pilot performance.
- Finished the development of new tests of complex cognitive abilities that relate to situational awareness (human perception and information integration of elements in the environment such as other aircraft, terrain, system status and warning lights) during flight.
- Finalized integration of new technologies (non-cognitive and abilities) of whole person assessment for occupational selection and classification.
- Completed development of a methodology to use cluster sampling for valid Navy surveys. This allows researchers to use smaller samplings without biasing the results.
- Demonstrated new psychological assessment methods to predict successful adaptation to military service.

- **Sailor/Marine Career Management System**

Initiated:

- Initiated the job matchmaker program, Sailor/Marine assignment matchmaker that develops intelligent agents to assess desires and qualifications of Sailors/Marines as well as applying/analyzing incentives necessary to influence behavior.
- Began the development of a prototype multi-agent system for sailors in the service member/command intelligent agents program. Demonstrated intelligent software agents with the necessary level of associative intelligence and cognitive capability (human intelligence and aptitude as measured by speed and accuracy of processing verbal, quantitative and spatial information) to gather information pertinent to the service member/command. The objective is for these agents to assist the sailor and the detailer with the complex assignment process.

Completed:
- Completed the (E)-commerce technologies for personnel distribution and assignment program and developed a community-specific database of sailors and jobs to support further testing of the two-sided matching algorithm.
- Developed a robust simulation model capable of incorporating sailor command preferences. Developed experiments to test expected market behavior in the military environment.

- **Personnel Situation Monitoring, Analysis & Response Technologies**

Continued:
- Continued evaluation of alternatives to the Integrated Personnel Simulation Techniques program to validate the simulation algorithm.

Completed:
- Finished the Student Value Model program by transitioning the model to both basic and advanced technical training school planners.
- Demonstrated integration of the web view of statistical reports generated via extensible markup language application with models that exchange information across various platforms and with different communications media.

- **Advanced Interface Design & Training Capability**

Initiated:
- Initiated user profile development in support of new land attack mission.

Continued:
- Continued cognitive task analysis, flow development, task requirements, software requirements, and design of selected tasks and Human-Computer Interaction (HCI) components within the new land attack mission.
- Continued implementation of selected task and HCI designs into a rapid prototype for usability testing.

Completed:
- Completed task and HCI design of land attack tasks: Digital Gun Call for Fire; Tomahawk Land Attack Missile (TLAM) Block III Planning & Engagement Go Path (Preplanned Mission); TLAM Block III with Cell Allocation.
- Completed user profile development in support of new land attack mission.

FY 2003 PLANS

- **Whole Person Assessment**

Initiate:
- 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.

Continue:
- Continue the psychometrics of measures program and begin the transition to the non-cognitive measures advanced technology effort.
- Development continues in the usability and contents effort and delivery of software version 2.0 to the user.

Complete:
- Complete testing a cohort in the Recruit Training Center and A-school and begin data analysis on the cohort for the person-organization fit program. Finalize assessment of the degree of fit between the person and the organization. Transition results to the Attrition Reduction Technologies advanced technology effort.
- Finish the models of aptitude and interest effort and use measures of social judgments and personality to provide an overall structural model of individual and group differences. Deliver a stand-alone version of the interest inventory to an advanced technology effort.

- **Sailor/Marine Career Management System**

Initiate:
- Begin applied research effort, the broker agent program, to demonstrate a series of agents residing within the web-based marketplace that arbitrate between Sailor/Marine and command agents when optimal matches cannot be achieved.

Continue:
- Effort is ongoing to establish a database supporting the Sailor/Marine assignment matchmaker program and to develop a plan to integrate auction theory using intelligent agent technology.
- Continue the service member/command intelligent agents effort and integrate multi-agent system for Sailors into a "personnel mall." These intelligent agents will provide information at appropriate times to adequately advise service members of impending career milestones with recommended choices and provide commands with necessary manpower information to ensure proper personnel planning. The prototype will be an interactive web-based labor market for the labor allocation of military personnel.

- **Personnel Situation Monitoring, Analysis & Response Technologies**

Initiate:

- Begin emerging technology effort of an enterprise management system approach to manpower and personnel management. Optimization, simulation, and statistical forecasts will be developed to capture complexity of factors effecting manpower and personnel management.

Complete:

- Efforts complete to transition algorithm from the Integrated Personnel Simulation Technologies program to user.

- **Advanced Interface Design & Training Capability**

Initiate:

- Initiate workload assessment and allocation for land attack tasks.
- Initiate Training Analysis for Land Attack Human-Computer Interaction (HCI) rapid prototype

Complete:

- Complete cognitive task analysis, flow development, task requirements, software requirements, and design of selected tasks and Human-Computer Interaction (HCI) components within the new land attack mission.
- Complete implementation of selected task and HCI designs into a rapid prototype for usability testing.
- Complete Training Analysis for Land Attack HCI prototype

FY 2004 PLANS

- **Whole Person Assessment**

Initiate:

- Initiate applicant cultures and values program to assess the practicality and predictive validity of socialization measures for selection into the military.

Complete:

- Complete the psychometrics of measures program, a suite of non-cognitive metrics for ascertaining individual differences.
- Development finishes in the usability and contents effort that provides input parameters to the classification and assignment algorithm.
- Complete testing and validation of non-cognitive metrics for adaptability for military service.

- **Sailor/Marine Career Management System**

Continue:

- Continue applied research effort, the broker agent program, to demonstrate a series of agents residing within the web-based marketplace that arbitrate between Sailor/Marine and command agents when optimal matches cannot be achieved.

Complete:

- Effort wraps-up to establish the Sailor/Marine assignment matchmaker algorithm for assignment of Sailors to jobs.
- Complete the service member/command intelligent agents prototype cognitive Sailor agent to be used in web-based detailing.

- **Personnel Situation Monitoring, Analysis and Response Technologies**

Continue:

- Continue applied research effort in developing an integrated optimization, simulation and statistical manpower and personnel suite of decision support tools for manpower and personnel enterprise management system.

- **Advanced Interface Design & Training Capability**

Initiate:

- Initiate Land Attack Training Tool analysis and design

Complete:

- Complete workload assessment and allocation for land attack tasks.
- Complete Land Attack Training Tool analysis and design

FY 2005 PLANS

- **Whole Person Assessment**

Continue:

- Continue applicant cultures and values measures effort to assess the practicality and predictive validity of socialization measures for selection into the military.

- **Sailor/Marine Career Management System**

Complete:

- Finish the cognitive broker agent prototype to be used as the command intelligent agent in web-based detailing.

- **Personnel Situation Monitoring, Analysis and Response Technologies**

Continue:
- Continue validation and testing of out year forecasts, simulations models and optimization algorithms for enterprise management system.

- **Advanced Interface Design & Training Capability**

– No 6.2 effort

	FY 02	FY 03	FY 04	FY 05
Training Technologies	10,928	10,531	9,310	13,465

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 2002 ACCOMPLISHMENTS

- **Training Technologies for Distance Learning**

Initiated:
– Initiated a program on maintenance training support technology.
– Initiated programs on training and performance aiding, Interactive Electronic Technical Manuals, and Condition-Based Maintenance (IETMs/CBM) systems.
– Initiated program on psychometric and statistical issues in 5-vector model.
– Initiated program on role of cognitive style in multimedia training.
Continued:
- Continued program on intelligent agents for objective-based training.
Completed:
– Completed work on instructional authoring tools.
– Completed development of algorithms for generating optimal mentor-prototype pairings.

- **Virtual Technologies and Environments**

Initiated:
- Initiated immersive interaction applications for weapons handling for dismounted combatants in Virtual Environments (VE). Virtual Environments are a cost-effective training venue that can improve training effectiveness and enable improved capabilities in training for dynamic, high-tempo warfighting environments.
- Started Computer Generated Forces (CGF) aimed at improved techniques for human cognitive and behavioral modeling techniques to support realistically behaving simulated teammates and adversaries. This will create more challenging simulated adversaries for application in simulation based naval training. The consequence will be more effective training.
- Began Modeling and Simulation (M&S) studies to determine the appropriate architecture and tools for Close Quarters Battle (CQB) training.

Continued:
- Continued immersive interaction simulation of human locomotion for use in close quarters battle training.
- Continued effects of ship motion on onboard VE systems. Onboard training using VE systems can prepare students at sea, enhancing mission readiness. Ship motion can interfere and impede these systems, reducing the effectiveness of a valuable training tool.

Completed:
- Finished investigations into alternate visual and aural presentations for individual vehicle simulators. These studies will be used by Demo I researchers in developing simulation systems.

- **Visualization-based Training & Support Systems**

Initiated:
- Initiated exploration of multi-media visualization training techniques.

Completed:
- Completed exploration of multi-media visualization training techniques. Program is not planned to continue beyond FY02.

- **Instructional Strategies and Technologies**

Initiated:
- Began the study of the instructional impact of personified pedagogical agents in computer-based training of problem solving.

- Initiated the use of web-based research and knowledge crystallization tools to aid advanced students (such as Navy Post-Graduate School students in a military intelligence course) to become more independent learners and thinkers.

Continued:
- Continued work on the Physics Tutor. This effort improves instructional effectiveness to aid students in solving problems on their own as well as advancing the state-of-the-art of intelligent tutoring in general by comparing the effectiveness of alternative instructional strategies.
- Continued work on instructional authoring tools designed to improve the efficiency and effectiveness of developing pedagogically sound computer based training tailored to military settings and training needs.

Completed:
- Completed work on artificially intelligent tutoring in dynamic decision-making.
- Completed work on augmenting displays to enhance learning
- Completed work on advancing applied cognitive task analysis.

- **Human Modeling for Simulation-based Training**

Initiated:
- Initiated tasks aimed at improved techniques for human cognitive and behavior modeling to support realistically behaving simulated teammates and adversaries to achieve more challenging and realistic simulation-based training and a reduction in the number of human controllers required as role players in large scale simulations.
- Initiated tasks assessing the capability of Computer Generated Forces (CGFs) to act as instructional agents for scenario generation and provide coaching and feedback, aimed at reducing training personnel costs by at least 25%.
- Started tasks aimed at developing enhanced modeling techniques for representing individual differences such as produced by differing levels of training, aptitude, and experience, making CGF performance less predictable and less gameable.

Continued:
- Continued tasks that created highly realistic simulated teammates to support team training relevant to shipboard combat information center activities.

Completed:
- Finished work on computer generated forces aimed at development of simulated team members to insert into team training and intelligent tutoring systems.

FY 2003 PLANS

- **Training Technologies for Distance Learning**

Initiate:
– Start development of optimized strategies for performance aiding and training.
– Begin development of measures to link shared cognition with team performance.
Continue:
– Continue program on maintenance training support technology.
– Continue programs on training and performance aiding, Interactive Electronic Technical Manuals, and Condition-Based Maintenance (IETMs/CBM) systems.
– Continue program on psychometric and statistical issues in 5-vector model.
– Continue program on intelligent agents for objective-based training.
Complete:
- Complete program on role of cognitive style in multimedia training.

- **Virtual Technologies and Environments**

Initiate:
- Initiate training aid research for Close Quarters Combat (CQB). These devices will assist the trainee to understand the spatial relationships critical to fighting in a close quarter battle.
Continue:
- Continue immersive interaction applications for weapons handling for dismounted combatants in Virtual Environments (VE). Continue Computer Generated Forces (CGF) aimed at improved techniques for human cognitive and behavioral modeling techniques to support realistically behaving simulated teammates and adversaries. Continue modeling and simulation (M&S) to develop the architecture and tools for CQB training.
- Continue immersive interaction simulation of human locomotion for use in CQB training.
- Continue effects of ship motion on onboard VE systems.

- **Instructional Strategies and Technologies**

Continue:
- Continue the study of the instructional impact of personified pedagogical agents in computer-based training of problem solving.
- Continue work on effective feedback in artificially intelligent tutoring for dynamic task environments such as anti-air warfare, instrument flying and other characteristic military tasks.
- Continue 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.

Complete:
- Develop a class of instructional authoring tools emphasizing simulation and artificially intelligent tutoring of trouble-shooting for maintenance training, including the capability to deliver the resulting instruction over the Internet.

- **Human Modeling for Simulation-based Training**

Initiate:
- Begin task to develop multi-agent based architectures for modeling human behavior with the goal of exploiting the inherent modularity of these architectures to enhance the reusability and therefore, affordability of modeling.
- Initiate task to apply novel architectural strategies that can facilitate the re-use of human behavior models or model components in applications that vary in their resolution requirements and tasks.

Continue:
- Continue task aimed at improved techniques for human cognitive and behavioral modeling to support more realistically behavior simulation teammates and adversaries.
- Continue task to improve the capability of Computer Generated Forces (CGFs) to act as instructional agents for scenario generation and to provide coaching and feedback.
- Continue task to develop enhanced modeling techniques for representing individual differences such as produced by differential levels of training, aptitude, and experience.
- Continue task to create highly realistic simulated teammates to support team training relevant to shipboard combat information center activities.

FY 2004 PLANS

- **Training Technologies for Distance Learning**

Continue:
- Continue program on intelligent agents for objective-based training.
- Continue development of optimized strategies for performance aiding and training.

Complete:
- Complete program on psychometric and statistical issues in 5-vector model.
- Complete development of measures to link shared cognition with team performance.

- **Virtual Technologies and Environments**

Initiate:
- Initiate Virtual Technologies and Environments (VIRTE) Demo III, Full Spectrum Combat. Building upon the foundations of VIRTE Demos I and II, Demo III will research issues associated with integrating many different military domains into a distributed simulation.

Continue:
- Continue immersive interaction applications for weapons handling for dismounted combatants in Virtual Environments (VE). Continue Computer Generated Forces (CGF) aimed at improved techniques for human cognitive and behavioral modeling techniques to support realistically behaving simulated teammates and adversaries. Continue modeling and simulation (M&S) to develop the architecture and tools for Close Quarters Combat (CQB) training.
- Continue immersive interaction simulation of human locomotion for use in CQB training.
- Continue effects of ship motion on onboard VE systems. Continue training aid research for CQB. These devices will assist the trainee understand the spatial relationships critical to fighting in a close quarter battle.

- **Instructional Strategies and Technologies**

Initiate:
- Begin systematic program of research addressing unanswered questions regarding effective instructional strategies in artificially intelligent tutoring.
- Initiate research on instructional strategy issues specific to distance learning applications of computer-based instruction, especially artificially intelligent tutoring.

Continue:
- Continue the study of the instructional impact of personified pedagogical agents in computer-based training of problem solving.
- Continue investigating strategies for artificially intelligent real-time coaching in dynamically evolving environments, such as are characteristic of military tasks and jobs.

Complete:
- Complete physics tutor project.

- **Human Modeling for Simulation-based Training**

Initiate:
- Initiate task to evaluate new algorithms to improve the robustness (capability to react appropriately to unanticipated contingencies) of human behavior models operating in military simulations.

- 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 by 50% the costs of these activities.

Continue:
- Continue task aimed at improved techniques for human cognitive and behavioral modeling to support more realistically behavior simulation teammates and adversaries.
- Continue task to develop enhanced modeling techniques for representing individual differences such as produced by differential levels of training, aptitude, and experience.
- Continue task to create highly realistic simulated teammates to support team training relevant to shipboard combat information center activities.
- Continue task to develop multi-agent based architectures for modeling human behavior with the goal of exploiting the inherent modularity of these architectures to enhance the reusability and therefore, affordability of modeling.
- Continue task to apply novel architectural strategies that can facilitate the re-use of human behavior models or model components in applications that vary in their resolution requirements and tasks.

Complete:
- Complete task to improve the capability of computer generated forces to act as instructional agents for scenario generation and to provide coaching and feedback.

FY 2005 PLANS

- **Training Technologies for Distance Learning**

Continue:
– Continue development of optimized strategies for performance aiding and training.

Complete:
– Complete program on intelligent agents for objective-based training

- **Virtual Technologies and Environments**

Continue:
- Continue immersive interaction applications for weapons handling for dismounted combatants in Virtual Environments (VE). Continue Computer Generated Forces (CGF) aimed at improved techniques for human cognitive and behavioral modeling techniques to support realistically behaving simulated teammates and adversaries. Continue modeling and simulation (M&S) to develop the architecture and tools for Close Quarters Battle (CQB) training.
- Continue the immersive interaction simulation of human locomotion for use in Close Quarters Battle training.

- Continue effects of ship motion on onboard VE systems. Continue the Training Aid research for CQB. Continue virtual Technologies and Environments (VIRTE) Demo III, Full Spectrum Combat.

- **Instructional Strategies and Technologies**

Initiate:
- Initiate investigation of instructional strategy issues specific to artificially intelligent training systems designed to train military teams together, working in teams, whether in the same or distributed locations.

Continue:
- Continue the study of the instructional impact of personified pedagogical agents in computer-based training of problem solving.
- Continue investigating strategies for artificially intelligent real-time coaching in dynamically evolving environments, such as are characteristic of military tasks and jobs.
- Continue systematic program of research addressing unanswered questions regarding effective instructional strategies in artificially intelligent tutoring.
- Continue research on instructional strategy issues specific to distance learning applications of computer-based instruction, especially artificially intelligent tutoring.

Complete:
- No completions in FY05.

- **Human Modeling for Simulation-based Training**

Initiate:
- Initiate task to apply in the context of a simulation for Naval training a set of 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.

Continue:
- Continue task aimed at improved techniques for human cognitive and behavioral modeling to support more realistically behavior simulation teammates and adversaries.
- Continue task to develop multi-agent based architectures for modeling human behavior with the goal of exploiting the inherent modularity of these architectures to enhance the reusability and therefore, affordability of modeling.
- Continue task to apply novel architectural strategies that can facilitate the re-use of human behavior models or model components in applications that vary in their resolution requirements and tasks.

- Continue task to create highly realistic simulated teammates to support team training relevant to shipboard combat information center activities.
- Continue task to evaluate new algorithms to improve the robustness of human behavior models operating in military simulations.
- Continue 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 by 50% the costs of these activities.

Complete:
- Complete task to develop enhanced modeling techniques for representing individual differences such as produced by differing levels of training, aptitude, and experience.

	FY 02	FY 03	FY 04	FY 05
Expeditionary Logistics	7,272	7,008	0	0

The Expeditionary Logistics addresses surface distribution considerations and supports efforts in logistics modeling and simulation. Reconstitution and indefinite forward force Sustainment relate to the Seabasing component of Seapower 21, Expeditionary Maneuver Warfare (EMW), and aspects of Sea Strike and Sea Shield. These Naval activities hinge on timely and responsive logistics operations at sea. Investment focus areas encompass surface replenishment of the seabase from Naval and commercial shipping as a force multiplier, and internal Seabase material and cargo handling and conveyance mechanisms for selective off-load. Logistics concepts will also be emphasized through the addition of logistics modeling and simulation activities within the Naval Simulation System and the Joint Wargaming System.

FY 2002 ACCOMPLISHMENTS:

- **Strike Up/Strike Down Systems**

Initiated:
- Initiated development of selective offload system for automated storage and retrieval, suitable for Amphibious and Logistics ships. Considered acceleration to install on a potential sea base demonstration ship. Technical emphasis was on load stabilization, control systems, and component marinization.
- Initiated development of Sensor Based Dynamic Manipulation work to support cargo movement. Performer worked to integrate a control system for robotic arm manipulation and continuous visual sensing via manipulation algorithms. Technical emphasis was on imaging, robotics, and real-time network algorithm manipulation.

- **Seabase to Shore Surface Craft**

Completed:
– Completed a matrix of technology capabilities and short falls to focus efforts and refine execution strategy. Study included review of the Landing Craft Air Cushion (LCAC), the Landing Craft Unit (LCU), and the sea state 3 (SS3) Lighters.

- **Ship to Shore/Skin to Skin Material Transfer**

Completed:
- Completed skin to skin material transfer technology feasibility investigations. Independent studies examined the potential to develop new fendering materials, at-sea ship securing systems, future crane technology and surfactants.

- **Logistics Wargame Simulators**

Continued:
– Continued the commander behavior module. Proceeded with the technology insertion into the Naval Simulation System baseline. Transitioned the capability set to the PE0603236N program plan for the Combat Service Support (CSS) Tool Kit supporting Logistics Command and Control.
Completed:
- Finalized the weather module concept development. Proceeded with technology insertion into the Joint Warfare System (JWARS) simulation system.

FY 2003 PLANS:

- **Strike Up/Strike Down Systems**

Continue:
- Continue investigation/development of technologies for selective offload and cargo movement.

Complete:
- Transition technology to the PE0603236N maturation component of the Expeditionary Logistics (ExLog) FNC investment.

- **Seabase to Shore Surface Craft**

Initiate:
- Initiate ship to shore transfer technology development in propulsion, creating 30% greater thrust with the new propulsors, but fitting in the same space as the existing propulsors (to fit in a well deck and keep the drive thru lane on the aft end of the LCAC).
- Initiate work to reduce fan maintenance, including innovative aerodynamic and material technologies to develop a propulsion fan that generates the required thrust efficiently and improves the reliability and maintainability of the propulsion fans.

Complete:
- Transition technologies to the PE0603236N technology demonstration program within the ExLog FNC.

- **Ship to Shore/Skin to Skin Material Transfer**

Initiate:
- Initiate skin to skin material transfer technology development emphasizing fendering materials and alternative crane concepts.

Complete:
- Transition technology development to technology demonstration PE0603236N ExLog FNC program plans.

- **Logistics Wargame Simulators:** N/A

FY 2004 PLANS: NA

FY 2005 PLANS: NA

	FY 02	FY 03	FY 04	FY 05
Littoral Combat / Power Projection	0	0	1,150	3,625

This activity provides 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. This includes efforts to provide advanced high speed inter theater sealift configurations, in particular projects to mature friction drag reduction concepts. 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 2002 ACCOMPLISHMENTS: NA

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602236N Project Title: Warfighter Sustainment Applied Research
PROGRAM ELEMENT TITLE: Warfighter Sustainment Applied Research

FY 2003 PLANS: NA

FY 2004 PLANS:

Initiate:
- Initiate software development for dynamic planning and adaptive execution of Expeditionary Maneuver Warfare via domain interpretation rules, active templates, and intelligent agents.

FY 2005 PLANS:

Continue:
- Continue development of dynamic planning and adaptive execution software by adding functionality and demonstrating during a scheduled training exercise.

	FY 02	FY 03	FY 04	FY 05
Energy Conversion	2,104	0	0	0

Energy conversion efforts address technology development to provide significant improvements in energetic material systems and subsystems in terms of performance, safety, reliability, and affordability, and to transition advanced technology to the Fleet for warfighter sustainment. Goals include: advanced energetic materials for warheads and propellants with superior performance and acceptable insensitivity characteristics to reduce vulnerability to both personnel and platforms; and reliable simulation tools and diagnostics to (1) develop and design superior performance reduced vulnerability systems tailored to specific warfighter missions, (2) improve safety, and (3) reduce cost by enabling simulation aided design and condition-based monitoring capabilities. This work develops technologies for cost-effective design, performance assessment, and vulnerability assessment of enhanced performance, insensitive munitions.

FY 2002 ACCOMPLISHMENTS:

Initiated:
- Evaluation of advanced fuels for enhanced explosive and propellant applications. These are metal based fuels which offer the potential to significantly improve the performance of energetic materials by enhancing ignition times and tailoring rates of energy release. (Effort discontinued due to program priorities).
- Development of a capability to tailor propellant performance to combustion characteristics. This will permit the a-priori optimization of propellant formulation design in order to tailor the safe operating regime of the propellant to the system requirements. (Effort discontinued due to program priorities).

- Development of the capability to predict effects of ballistic modifiers on propellant performance parameters. This capability will permit one to tailor the pressure-combustion rate dependence of next generation propellants using current ballistic modifiers with a-priori design criteria and eliminate many of the empiricisms currently inherent to the development process. (Effort discontinued due to program priorities).
- Development of the capability to predict effects of energetic components on propellant burn rate parameters. This would permit the maximization of performance while simultaneously avoiding catastrophic propellant failure when new designs or design changes are implemented. (effort discontinued due to program priorities).
- Development diagnostics to monitor response of energetic materials to external stimuli. These diagnostics are essential in the understanding of how mechanical energy is absorbed into an energetic material and if it leads to detonation or will quench. (Effort discontinued due to program priorities).
- Calibration of laboratory scale diagnostics to accurately determine underwater explosive performance and validate with large scale test results. This capability would enable laboratory characterization of the small quantities of experimental explosives initially available without the need to invest significant time and resources into material scaleup. (Work transferred in FY03 to PE 0602747N).

Completed: (This work was previously funded in PE 0601153N)

- Completed a 1st generation model to predict effects of ammonium perchlorate size effects on propellant burn rate parameters.

FY 2003 PLANS: *

FY 2004 PLANS: NA

FY 2005 PLANS: NA

	FY 02	FY 03	FY 04	FY 05
Advanced Naval Materials	21,952	21,941	15,296	17,692

Advanced Naval Materials efforts address significant improvements in terms of affordability, reliability and performance to transition advanced technology to the Fleet for warfighter sustainment. Goals 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; environmentally acceptable long-life coatings for aircraft and ships to improve the quality of life for sailors; advanced low cost welding and joining methods, and new low cost sensors. Turbine improvement efforts cover the Navy's share of the turbine engine component development efforts under the Department of Defense (DOD)/National Aeronautics and Space Administration (NASA) Industry Integrated High Performance Turbine Engine Technology (IHPTET) program, ensuring that Navy unique design and operational requirements are met. Also included are aircraft and ship electrical power generation and thermal management technologies. Airframe and ship corrosion efforts address an integrated

approach for the control of the effects of external and internal corrosion. The work develops advanced cost effective prevention and life cycle management technologies. This is particularly significant to life extension for the aging fleet. This activity supports the Total Ownership Cost (TOC) Reduction Future Naval Capability.

FY 2002 ACCOMPLISHMENTS:

- **Structural Materials**

Initiated:
- Initiated development of improved welding consumables for superior strength (greater than 110 ksi)/toughness ship steels. This will provide the Navy with superior performance weld metal with minimized preheat for affordable construction of future ships.
- Began development of higher temperature aluminum alloys. These materials will reduce weight and cost of components, now fabricated from titanium, in the front end of naval gas turbine engines.
- Started investigations of a nondestructive evaluation technique based on the thermographic imaging of structures. Preliminary results indicate it to be very sensitive for the detection of small cracks in naval structures.

Continued:
- Continued stress corrosion tests on friction stir welded advanced amphibious assault vehicle (AAAV) aluminum alloy. This will enable the Marine Corps to select lower cost joining technologies for the AAAV, which yield aluminum alloy microstructures not susceptible to stress-corrosion cracking.
- Continued friction stir welding of steels effort to develop apparatus and processing routes for superior solid state welds in ship structures. This will provide Navy with technique that drastically reduces weld fume and distortion/enhances stealth and affordability in ship construction.
- Continued development of compositions and processing for more affordable, higher performance ship steels such as HSLA-65. This will provide the Navy with ship steels of superior strength/toughness and affordability, and significant weight reduction.
- Continued development and evaluation of weld processing of stainless steel for more affordable superior performance welds. This will provide the Navy with welding technology to fabricate non-magnetic, stealthy ships.
- Continued development of ultra-light heat exchanger for the E-2C aircraft. A planned upgrade in the E-2C radar requires heat dissipation beyond that achievable with standard pin-on-fin heat exchangers. This program will provide that capability and obviate expensive aircraft structural changes.
- Continued development of advanced carbon/carbon materials processes for missile heat shield applications for naval strategic missiles. This work will provide replacements for no-longer available materials and develop better, more affordable new heat shield materials.

- Continued development of advanced composites and polymers with fire resistance for ship structures. Present day composite materials ignite easily generating thick and toxic fumes, therefore are not safe for man rated areas.
- Continued development of mechanics analysis for glass fabric composite structures for future naval topside structures. This will provide the Navy with guidance for the rational selection of material design allowable based on material damage.

Completed:

- Completed pulse thermographic imaging developed for defect characterization in naval structures. This is a portable, wide-area and non-contact inspection technology with significant promise for maintenance cost reduction.
- Finished effort to optimize the damage tolerance response versus the vibration damping characteristics of reinforced polyurethane composites for cost and weight reduction on future Navy ships.
- Completed bismalidie (BMI) composite (patch development) development for high temperature repair applications of present and future naval aircraft. Present epoxy patch technology does not meet the demanding aerospace material requirements.
- Demonstrated superior new MIL-100S welding wire for welding ship steels. This provides the Navy with improved weld metal for welding of HSLA steels with the elimination/minimization of preheat and thus enhanced affordability in ship and submarine construction.
- Concluded pressure/shock testing of cast lattice block material (LBM) water-tight doors. LBM cast steel doors will lead to reduced maintenance (less distortion) and reduced weight.

- **Functional Materials**

Initiated:

- Initiated assessments of applications of high force actuators for naval structures. These actuators will allow active control of structural vibrations reducing acoustic radiation from undersea vehicles, for example, in torpedo acoustic stealth applications.
- Started developments of high strain-high force actuators for sonar source applications. These sonar transducers will allow reduction in device sizes by factors ranging from three to six in applications such as torpedo homing sonar and torpedo countermeasure decoys.

Continued:

- Continued development of frequency agile polymers for application in laser eye protection. These new nonlinear optical limiter materials will protect our sailors and marines from ever changing laser threats.
- Continued development of multi-functional transducer materials. These composite piezoelectric materials can have their properties tailored to meet the requirements of a broad range of sonar systems ranging from submarine

obstacle avoidance sonar through multi-line towed hydrophone arrays to Unmanned Underwater Vehicle (UUV) mounted mine hunting sonar.
- Continued evaluation of advanced transducer single crystal high strain materials. These materials will revolutionize essentially all Navy sonar devices by doubling bandwidths and increasing energy densities more than an order of magnitude.

Completed:
- Completed evaluation of capacitive micromachined ultrasonic transducers for diver-held undersea imagers.

- **Maintenance Reduction Technologies**

Initiated:
- Initiated development of materials and processes for high temperature turbine disks. These materials/processes are needed to provide improved performance, durability and decreased operational cost in future naval gas turbine engines.
- Started development of multi-laser-processing technology for the fabrication of ultra hard materials. This revolutionary new technology will allow us to reclaim old components back into service or produce new components with zero maintenance requirements.
- Initiated work on advanced smart wires for rapid aircraft maintenance. This will provide the Navy and Marine Corps the ability to rapidly diagnose defects in wiring and significantly reduce the time required for maintenance of complex wiring in aircraft and ships.
- Began developing single coat corrosion control coatings for potable water ship tanks. This new coating will replace current five and three coat systems thereby reducing costs.
- Initiated new wash-down processes for United States Marine Corps (USMC) vehicles using recyclable corrosion inhibitors. This will provide the Marine Corps with advanced corrosion control technology and contribute to life extension of vehicles such as the High Mobile Multi-Purpose Wheeled Vehicle (HMMWV).
- Initiated development of standardized road test methodology and coating test metrics for the USMC vehicles that emulate real marine environment.
- Initiated corrosion monitoring sensors to enable early detection of corrosion in hidden/hard-to-reach areas in the aircraft.
- Started developing longer-life, low maintenance Modular Hybrid Pier (MHP).
- Initiated developing longer life, enhanced performance self-priming coating and Corrosion Preventive Compounds (CPC) for the aircraft.
- Initiated spectral imaging/thermography technology for non-destructive evaluation (NDE) of naval materials and structures. This wide area imaging technique will lower the inspection time by 30% while enhancing its reliability of detection.

- Initiated fighter/helo arc fault circuit breaker (AFCB) development. This will provide the Navy and Marine Corps the capability to prevent electrical arcing in areas such as fuel tanks greatly enhancing safety of operation.
- Began demonstrating first cooled ceramic (zircon nitride) vane for gas turbine engines. Ceramic components are less susceptible to environmental degradation and will allow several hundred degrees elevation in engine operating temperature.

Continued:

- Continued development of environmental barrier coatings for ceramics/composites to provide higher combustor operational temperatures and extended combustor life times for future naval gas turbine engines. This work is necessary to meet IHPTET Phase III goals and will transition into improved engines for future naval aircraft.
- Continued cadmium replacement technology development for corrosion control. This will provide the Navy with an environmentally acceptable technology for preventing corrosion and hydrogen embrittlement in high strength steel aircraft components such as landing gear and wing boxes.
- Continued development of environmentally acceptable coatings for nonmagnetic ship hulls. This will enable the Navy to select lower cost austenitic stainless steel as a non-magnetic hull material in preference to higher cost titanium alloys.
- Continued evaluation of upgraded seawater valves in land based tests. This will provide the Navy with 40-year valves in seawater systems, thereby eliminating valve replacements currently needed at 10-year intervals.
- Continued development of innovative composites casting technology for ship shafts and seals. This will allow the Navy to fabricate extraordinarily long life seals for propulsion shafts on Navy ships, enhancing combat readiness and affordability/reducing maintenance.
- Continued development of new thermal barrier technology using multiphase coatings for oxidation resistant molybdenum alloys, a likely candidate for the next generation of superalloys. These alloys will provide higher hot section operating temperatures for future naval gas turbine engines resulting in improved performance and decreased specific fuel consumption.
- Continued development of oxidation resistant molybdenum alloys that are leading candidates for the next generation of superalloys. These materials will provide major enhancement in performance and fuel economy for gas turbines by providing higher hot section capability and more thermodynamic efficiency.

Completed:

- Completed corrosion sensor development for condition based maintenance of ballast tanks. This enables the Navy to save maintenance costs by replacing a manual inspection process with an electrochemical monitoring technology for ship tanks.
- Finished ultrasonic imaging camera development for non-destructive evaluation (NDE) of naval materials and structures. This wide area imaging technique will lower the inspection time by 30% while enhancing its reliability of detection.

- Completed advanced applique technologies development for aircraft corrosion control. This will enable the Navy to save maintenance costs by employing easily replaceable stick-on coatings having both corrosion prevention and stealth properties.
- Completed development/evaluation/qualification of the ausform finishing process for aerospace steel gears. This will provide the Navy with superior technology to produce rotorcraft gears with greater load capability and longer service life.
- Finished bristle brush development for paint and corrosion product removal. This will provide the Navy with the ability to spot-repair aircraft paint coatings without having to re-paint the whole aircraft, thereby reducing maintenance costs.

- FY 2003 PLANS:

- **Structural Materials**

Initiate:
- Initiate the development of ultralight, blast resistant structural materials for force protection. These materials will have applications in protecting ship hulls, command and control centers, Marine Corps vehicles, personnel shelter walls, etc.
- Begin the development of low cost Phthalonitrile based organic resin materials with improved fire resistant behavior. These resins will be instrumental for the introduction of composite materials in all man rated areas aboard ships.
- Initiate the development of new process for fabrication of fiber reinforced foam material for structural applications. These materials will have applications in next generation cored composite top side structures.

Continue:
- Continue friction stir welding of steels to drastically reduce weld fume and distortion, enhancing stealth and affordability, in ship construction.
- Continue development of compositions and processing for more affordable, higher performance ship steels such as HSLA 65 for significant weight reduction.
- Continue development and evaluation of weld processing of stainless steel for fabrication of non-magnetic, stealthy ships.
- Continue development of improved welding consumables for superior strength with minimized preheat, for affordable construction of future ships.
- Continue development of advanced carbon composite processes for missile heat shield applications for naval strategic missiles.
- Continue development of advanced composites and polymers with fire resistance for ship structures.

- Continue development of mechanics analysis for glass fabric composite structures for future naval topside structures.
- Continue multi-laser-processing technology for the fabrication of ultra hard materials to produce new components with zero maintenance requirements.

Complete:

- Complete stress corrosion tests on friction stir welded advanced amphibious assault vehicle (AAAV) aluminum alloy. This will enable the Marine Corps to select lower cost joining technologies for the AAAV which do not yield aluminum alloy microstructures susceptible to stress-corrosion cracking.
- Complete investigations of a new nondestructive evaluation technique based on the thermographic imaging of structures excited ultrasonically. Preliminary results indicate it to be very sensitive for the detection of small cracks in naval structures.
- Complete development of ultra-light heat exchanger for the E-2C aircraft. A planned upgrade in the E-2C radar requires heat dissipation beyond that achievable with standard pin-on-fin heat exchangers. This program will provide that capability and obviate expensive aircraft structural changes.
- Complete ultrasonic imaging camera development for non-destructive evaluation (NDE) of naval materials and structures. This wide area imaging technique will lower the inspection time by 30% while enhancing its reliability of detection.

- **Functional Materials**

Initiate:

- Initiate evaluation of single crystal transducer materials' mechanical strength under Naval operating conditions.

Continue:

- Continue to develop multifunctional transducer materials for a broad range of sonar systems.
- Develop high-force high-strain actuators for active control of structural vibrations reducing acoustic radiation from undersea vehicles.
- Continue evaluation of advanced transducer single crystal high-strain materials to revolutionize essentially all Navy sonar devices by doubling bandwidths and increasing energy densities.

Complete:

- Complete frequency agile polymers for application in laser eye protection and transition to the "Warfighter Protection" FNC.

- **Maintenance Reduction Technologies**

Initiate:
- Initiate shipboard testing of upgraded seawater valves to provide the Navy with 40-year valves.
- Begin 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.
- Start development of novel thermal barrier coating technology for gas turbine engine hot section components. Thermal barrier coating reduces hot section metal temperature, thus prolonging engine life and permitting improved operational performance in naval engines.
- Initiate evaluation of joint behavior effects on materials for modular hybrid pier construction.

Continue:
- Continue development of environmental barrier coatings for ceramics/composites to provide higher combustor operational temperatures and extended combustor life times for future naval gas turbine engines.
- Continue cadmium replacement technology development to provide the Navy with an environmentally acceptable technology for high strength steel components.
- Continue multi-laser-processing technology for the fabrication of ultra hard materials to produce new components with zero maintenance requirements.
- Continue development of environmentally acceptable coatings for corrosion protection for nonmagnetic ship hulls.
- Continue development of innovative composites casting technology for ship shafts and seals.
- Continue development of new thermal barrier technology using multiphase coatings for oxidation resistant molybdenum alloys, to provide higher hot section operating temperatures, resulting in improved performance and decreased specific fuel consumption.
- Continue development of oxidation resistant molybdenum alloys to provide major enhancement in performance and fuel economy for gas turbines.
- Continue development of materials and processes for high temperature turbine disks.
- Continue development of higher temperature aluminum alloys to reduce weight and cost of components, now fabricated from titanium, in the front end of naval gas turbine engines.
- Continue development of advanced smart wire for rapid aircraft maintenance.
- Continue to develop single-coat corrosion control coatings for potable water ship tanks to replace current five-coat and three-coat systems thereby reducing coats.
- Continue the development of new wash-down processes for USMC vehicles using recyclable corrosion inhibitors to provide advanced corrosion control technology for life extension of vehicles such as the HMMWV.
- Continue to develop standardized road test methodology and coating test metrics for the USMC vehicles that emulate real marine environment.
- Continue to develop corrosion monitoring sensors to enable early detection of corrosion in hidden/hard-to-reach areas in aircraft.

- Continue to develop longer-life, low-maintenance Modular Hybrid Pier (MHP).
- Continue to develop longer-life, enhanced-performance, self-priming coating and Corrosion Prevention Compounds (CPC) for aircraft.
- Continue to develop spectral imaging/thermography technology for NDE of naval materials and structures to lower the inspection time by 30% while enhancing reliability of detection.
- Continue to develop fighter/helicopter arc fault circuit breaker (AFCB) technology to provide the capability to prevent electrical arcing in areas such as fuel tanks; greatly enhancing safety of operation.

Complete:
- Complete land based tests of upgraded seawater valves. This will provide the Navy with 40-year valves in seawater systems, thereby eliminating valve replacement currently needed at 10-year intervals.

FY 2004 PLANS:

- **Structural Materials**

Initiate:
- Initiate development of integrated structural composites with blast resistance for next generation destroyer applications. Part of this effort will be to develop those manufacturing technologies that will allow the economic integration of functionally diverse materials.

Continue:
- Continue development of ultra light, blast resistant structural materials for force protection and to protect ship hulls, command and control centers, Marine Corps vehicles, personnel shelters, etc.
- Continue development of advanced carbon composite processes for missile heat shield and propulsion applications.
- Continue low cost Phthalonitrile based organic resin material development with improved fire resistance.
- Continue process development for fabrication of fiber reinforced foam material for structural applications. These materials will have applications in next generation cored composite top side structures.
- Begin the development of advanced composites and polymers with fire resistance for ship structures.

- **Functional Materials**

Initiate:
- Develop acceptance testing methodologies for advanced transducer single-crystal high-strain materials. Define standardized materials properties and composition ranges.

Continue:
- Continue to evaluate single crystal transducer materials mechanical strength under Naval operating conditions.

- Continue to develop multifunctional transducer material.
- Continue to develop high-force high-strain actuators for structural applications and sonar transducers.

Complete:

- Complete evaluation of advanced transducer single crystal high strain materials. These materials will revolutionize essentially all Navy sonar devices by doubling bandwidths and increasing energy densities by more than an order of magnitude.

- **Maintenance Reduction Technologies**

Initiate:

- Initiate the development of electrospark deposited coatings and scratch/hole fillers for corrosion and wear applications.
- Initiate portable, real-time, wide area nondestructive inspection (NDI) technology for crack and disbondment detection on substructures on the aircraft.

Continue:

- Continue the development of durable new materials for naval gas turbine engine hot sections.
- Continue the development of novel thermal barrier coating technology for gas turbine engine hot section components to prolong engine life,
- Continue multi-laser-processing technology for the fabrication of ultra hard materials to produce new components with zero maintenance.
- Continue the development of innovative composites casting technology for long life ship shafts and seals.
- Continue the development of environmental barrier coatings for ceramics/composites to provide higher combustor operational temperatures and extended combustor life times for gas turbine engines.
- Continue the development of new thermal barrier technology to provide higher hot section operating temperatures for improved performance.
- Continue the development of materials and processes for high temperature turbine disks.
- Continue the development of higher temperature aluminum alloys to reduce weight and cost of components, now fabricated from titanium.
- Continue shipboard testing of upgraded seawater valves to provide the Navy with 40-year valves.
- Continue cadmium replacement technology development to provide the Navy with an environmentally acceptable technology for high strength steel components.
- Continue the development of environmentally acceptable coatings for corrosion protection for nonmagnetic ship hulls.

- Continue the development of standardized road test methodology and coating test metrics for the USMC vehicles that emulate real marine environment.
- Continue the development of longer-life, enhanced-performance self-priming coating and Corrosion Preventive Compounds (CPC) for aircraft.
- Continue the development of spectral imaging/thermography technology for NDE of naval materials and structures.

Complete:

- Finish development of oxidation resistant molybdenum alloys to provide major enhancement in performance and fuel economy for gas turbines.
- Complete the development of single coat corrosion control coatings for fuel-compensated water ship tanks.
- Complete the development new wash-down processes using recyclable corrosion inhibitors to provide the Marine Corps with advanced corrosion control technology.

FY 2005 PLANS:

- **Structural Materials**

Initiate:

- Initiate development of vapor-phase corrosion inhibitor emitters for the protection of shipboard electronics and computers.
- Initiate development of new environmentally friendly, affordable and structurally sound Bio-Composite materials for the Navy after next. New genetic manufacturing routes will allow key structural and functional qualities never achieved before while using conventional fabrication methods.

Continue:

- Continue the development of ultralight, blast resistant structural materials for ship hulls, command and control centers, Marine Corps vehicles, personnel shelters, etc.
- Continue the development of advanced carbon composite processes for missile heat shield and propulsion applications.
- Continue the development of integrated structural composites with blast resistance for next generation destroyer applications. Part of this effort will be to develop those manufacturing technologies that will allow the economic integration of functionally diverse materials.
- Continue low-cost Phthalonitrile-based organic resin material development with improved fire resistance.

- **Functional Materials**

Initiate:

- Begin the development of capacitors with ultra-high dielectric constants for increased storage capability and significantly reduced size. Capacitors with increased energy density will provide projected energy storage and conditioning requirements to enable electric force concepts.
- Start development of compositional-tuning, single-crystal, high-strain transducer materials, for specialized Naval system applications.

Continue:

- Continue to evaluate single crystal transducer materials mechanical strength under Naval operating conditions.
- Continue to develop multifunctional transducer materials for a broad range of sonar systems.
- Continue development of high-force high-strain actuators for structural applications and sonar transducers for active control.
- Continue to develop acceptance testing methodologies for advanced transducer single-crystal high-strain materials.

- **Maintenance Reduction Technologies**

Initiate:

- Initiate portable, real-time, wide area nondestructive inspection (NDI) technology for heat damage detection on composite materials.

Continue:

- Continue development of durable new materials for naval gas turbine engine hot sections.
- Continue development of novel thermal barrier coating technology for gas turbine engine components to prolong engine life.
- Continue development of innovative composites casting technology for ship shafts and seals to enhance combat readiness and reduce maintenance.
- Continue multi-laser-processing for the fabrication of ultra hard materials to produce components for zero maintenance requirements.
- Continue development of environmental barrier coatings for ceramics/composites to provide higher combustor operational temperatures and extended combustor life times for future naval gas turbine engines.
- Continue development of new thermal barrier technology using multiphase coatings for oxidation resistant molybdenum alloys to provide higher hot section operating temperatures for future naval gas turbine engines.
- Continue development of materials and processes for high temperature turbine disks.
- Continue development of higher temperature aluminum alloys to reduce weight and cost of components for gas turbine engines.

- Continue development of electrospark deposited coatings and scratch/hole fillers for corrosion and wear applications.
- Continue shipboard testing of upgraded seawater valves to provide 40-year valves in seawater systems.
- Continue cadmium replacement technology development to provide an environmentally acceptable technology for preventing corrosion and hydrogen embrittlement in high strength steel.
- Continue development of environmentally acceptable coatings for corrosion protection for nonmagnetic ship hulls.
- Continue to develop single coat corrosion control coatings for Collection, Holding and Transfer (CHT) water ship tanks. This new coating will replace current five-coat and three-coat systems thereby reducing coats.
- Continue to develop new wash-down processes to provide the Marine Corps with advanced corrosion control technology and contribute to life extension of vehicles such as the High Mobile Multi-Purposed Wheeled Vehicle (HMMWV).
- Continue to develop longer-life, enhanced-performance, self-priming coating.
- Continue to develop spectral imaging/thermography technology for non-destructive investigation (NDE) of naval materials and structures. This wide area imaging technique will lower the inspection time by 30% while enhancing its reliability of detection.

Complete:

- Complete Wide Area spectral imaging/thermography NDI technology.
- Complete development of Corrosion Preventive Compounds.

	FY 02	FY 03	FY 04	FY 05
Medical Technologies	17,371	16,738	17,163	15,524

Medical Technologies improve warfighter safety and enhance personnel performance capabilities under adverse conditions, enhance diagnosis of medical emergencies and treatment of casualties, and prevent costly occupational injury and disease in hazardous environments. Requirements which support technology development in these areas include: improving warfighting capabilities through enhanced supply and long-term storage of pre-positioned medical supplies such as blood; providing better stress endurance/control for key personnel; and providing enhanced casualty care onboard amphibious casualty receiving ships. This activity supports the Warfighter Protection Future Naval Capability.

FY 2002 ACCOMPLISHMENTS

- **Casualty Care and Management**

Initiated:
- Initiated the evaluation of the effects of a hemoglobin red cell substitute on brain injury. These studies will determine if use of a newly developed soluble hemoglobin product will reduce brain damage following blunt trauma.
- Initiated the evaluation of the effects of a colloidal resuscitation fluid on brain injury. These studies will determine if a newly approved colloidal resuscitation fluid reduces brain damage following blunt trauma.
- Initiated studies to assess the energy status of various organs following resuscitation with standard crystalloids. Phosphorus nuclear magnetic resonance (NMR) will be used to determine adenosine triphosphate (ATP) levels in an animal model of hemorrhage following resuscitation, thus determining which fluid provides optimal resuscitation.
- Initiated the evaluation of glycopeptide compounds with regards to efficacy in control of pain, addiction potential, potential for abuse, and sedative properties as a substitute for morphine. These studies are designed to identify a drug or drug formulation that will be as effective as morphine, the current standard of care.
- Initiated the development of a casualty management tool for Operational Maneuver from the Sea (OMFTS) and special operations. This tool will facilitate optimal distribution of medical supplies.

Continued:
- Continued the evaluation of a hemostatic dressing that contains an antimicrobial agent. Incorporation of an antimicrobial, in theory, should decrease the rate of infection and improve morbidity. Studies are designed to test whether this product design is effective.
- Continued the development of freeze-dried red blood cells. Continued evaluation on the impact of high pressures on lyophilization of red cells. By increasing ambient pressure, the movement of water out of red cells may be facilitated, thus improving the efficiency of freeze-drying and quality of the freeze-dried red cell.
- Continued efforts in the development of a hemoglobin substitute. Hemoglobin is the most effective oxygen carrier at present, but it is expensive to isolate and process; these studies will characterize oxygen-binding heme peptides (to be encapsulated in liposome's) that could be manufactured inexpensively.
- Continued applied research on the effects of Food and Drug Administration (FDA)-approved resuscitation fluids on the inflammatory response. Fluids employed in standard of care resuscitation appear to potentiate systemic inflammation; this study will determine which of the currently employed fluids is least likely to promote inflammatory injury.
- Continued applied research on extending the circulation time of the gas diffusion enhancer, trans-sodium crocetinate (TSC). TSC shows promise as an additive to resuscitation fluid, but currently it is excreted too rapidly to sustain tissue oxygenation for more than 20 minutes.

- Continued the evaluation in models of hemorrhage combined with head trauma of arginine supplementation of hypertonic saline resuscitation fluid. By supplying arginine, the substrate for nitric oxide, it is believed that nitric oxide levels will increase and improve perfusion of the brain.
- Continued the evaluation of the control of systemic inflammation by interleukin-II (IL-11). This cytokine, which is approved for human use, has shown promise for preventing intestinal injury following severe hemorrhage.
- Continued the assessment of nasal ketamine to relieve acute pain. This drug may have utility for controlling pain of injury and facilitating self-transport of casualties.
- Continued efforts in the investigation of the chemical properties of a hibernation factor. A factor isolated from hibernating squirrel serum has demonstrated the ability to protect cells from ischemic injury. The factor will be further characterized, cloned and tested in a small animal model of hemorrhage.
- Continued studies in the evaluation of the trauma applications of hand-held ultrasound diagnostic instruments in the field. The relative merits of two systems will be evaluated under field conditions with minimally trained operators to determine if these devices require further development.

Completed:

- Completed studies on evaluation of melatonin in hemorrhagic shock. Melatonin is a readily-available compound that was shown to prevent ischemic injury to the brain, and these studies will determine its full potential for treating head injury.
- Completed studies of the colloidal fluid resuscitation effects on the development of lung injury. Acute respiratory disease (ARD) is the major killer of hemorrhagic shock casualties; these studies evaluated various colloidal fluids that may prevent ARD.
- Completed the evaluation of the effect of hypertonic fluids on head injury (transition). Clinical studies have suggested that hypertonic resuscitation is beneficial in head injury, but the optimal fluid and protocol requires analysis in a head injury model including hemorrhage and resuscitation.
- Completed the evaluation of selected cytokines as predictive indicators of trauma outcome (transition). Data obtained in one clinical center will be replicated in two other clinical centers to determine whether effective markers of multiple organ failure have been identified.
- Completed studies of the effects of mild hypothermia on hemorrhagic shock outcomes. Mild hypothermia was shown to prevent head injury following hemorrhage in rats, but will be further assessed in a swine model for its utility in large species.

- **Casualty Prevention**

Initiated:

- Initiated development of technologies for enhanced body protection against battlefield munitions. In particular, studies will be performed to assess the amount of blunt force trauma damage that is experienced using current and proposed chest protection devices.
- Initiated development of an improved aircrew protection suit for operational aircraft. The suits will be targeted to platforms. High performance aircraft operations will focus on extending g-force tolerance for operators. Helicopter operations will attempt to improve safe operations in extreme heat and cold. Initiated work on a smart ensemble that assesses physiological status and integrates into aircraft control systems, to reduce risk associated with loss of situational awareness or consciousness.

Continued:

- Continued evaluation of malaria DNA vaccine gene sequences for protective efficacy. The optimal combination of oligomers for stimulating protective immunity is being determined based on protection tests in mice and monkeys.

Completed:

- Completed development of a model for the clearance of (insoluble) smoke particles from the lung in order to determine the optimal exposure limits for toxic exposure to smoke in Navy Firefighters.
- Completed examining the short- and long-term effects of acute and chronic exposure to hypobaric (high altitude aircraft and aircraft operations training chambers) oxygen. This work attempted to define the long term risk to personnel and develop new approaches to training and operations that reduce risk of injury from oxygen toxicity.
- Completed exploring effects of motion and acceleration and developing methods to predict and counteract the deleterious effects of low-to-high frequency acceleration (motion) in operational environments. Deleterious motion effects can range from extreme nausea to disorientation and have been identified as contributing factors in numerous fatal mishaps on ships and aircraft. Approaches to be studied include improved control surface and display design, optimal work-rest schedules, and diet and drug-based interventions.

- **Undersea Medicine**

Continued:

- Continued studies to evaluate immunological function during harsh operational conditions. Particular emphasis is placed on characterizing the changes in immunological factors which may predict susceptibility to viral or bacteriological immunological challenges.
- Continued effort to assess the impact of thermal (i.e., heat and cold) stress on operational performance in Navy and Marine Corps personnel. These studies will lead to the formulation of strategies to mitigate the performance decrements induced by exposure to thermal extremes.
- Continued the development of predictive measures for oxygen-induced seizures continued in the hope that a physiologically-based “early warning system” can be engineered to warn divers using hyperbaric oxygen of the impending likelihood of central nervous system seizures.

- Continued efforts to develop prophylactic agents to prevent hyperbaric oxygen toxicity in Navy and Marine Corps divers breathing pure oxygen at depth. These efforts will also identify physiological changes that occur after acute and chronic exposure to hyperbaric oxygen in order to assess if repeated exposure to hyperbaric oxygen increases the probability of seizure activity or brain damage with subsequent exposures.
- Continued the development of novel agents that prevent the neurological damage associated with decompression sickness in Navy divers. Decompression sickness remains a major medical problem in Navy divers.

Completed:

- Completed studies to compare and contrast performance during the 18-hour watchstanding schedules with schedules based upon a 24-hour day. The current submarine watchstanding schedules are based upon an "18-hour day" which may be less than optimal based upon research with shift-workers.

- **Healthy and Fit Force**

Initiated:

- Initiated building on research into the underlying processes for cellular repair, applied research into the regeneration of auditory and vestibular hair cells in the inner ear. This work will attempt to define the chemical changes in the cell during the damage process and develop target drug approaches that improve or imitate upon the body's own damage repair.
- Initiated exploring accident trends aboard reduced-crewed and high performance vessels such as fast boats, smart ships and next generation aircraft carriers to determine new approaches to reduce injury through improved design of workstations, seats, and controls. This effort will include studies of musculo-skeletal injury and how fitness and strength affect injury potential.

Continued:

- Continued to evaluate ways to protect hearing and balance through new protective systems. The effort includes studies of new materials that reduce noise levels when applied to personal hearing protection as well as structural insulations. Additional work will continue to develop clinical strategies and interventions such as new drugs to protect and restore hearing and balance progress.

FY 2003 PLANS

- **Casualty Care and Management**

Initiate:

- Initiate a project to evaluate the use of heart rate variability (HRV) as a predictor of survivability of casualties. This effort has direct implications on the assignment of limited resources for evacuation of casualties.
- Initiate a study evaluating the efficacy of a dehydroepiandrosterone (DHEA) analog (Androstenetriol; AET) to decrease mortality and morbidity of battlefield casualties.
- Initiate a study to evaluate the effectiveness of sublingual partial pressure of carbon dioxide (PC02) measurements to predict the onset of shock in patients. This method/device may improve management of casualties in shock due to trauma/hemorrhage.

Continue:

- Continue efforts in the development of a hemoglobin substitute.
- Continue the evaluation of the effects of a colloidal resuscitation fluid on brain injury.
- Continue studies to assess the energy status of various organs following resuscitation with standard crystalloids.
- Continue the evaluation of glycopeptide pain drugs.
- Continue the development of a casualty management tool for Operational Maneuver from the Sea (OMFTS) and special operations.
- Continue the evaluation of the effects of a hemoglobin red cell substitute on brain injury.
- Continue studies on the effects of Food and Drug Administration (FDA)-approved resuscitation fluids on the inflammatory response.
- Continue applied research on extending the circulation time of the gas diffusion enhancer, trans-sodium crocetinate (TSC).
- Continue the evaluation in models of hemorrhage combined with head trauma of arginine supplementation of hypertonic saline resuscitation fluid.
- Continue the evaluation of the control of systemic inflammation by the cytokine, IL-11.
- Continue studies in the evaluation of the trauma applications of hand-held ultrasound diagnostic instruments in the field.

Complete:

- Complete evaluation of a hemostatic dressing that contains an antimicrobial agent.
- Complete the development of freeze-dried red blood cells and evaluation of high pressures on lyophilization of red cells.
- Complete assessment of nasal ketamine to relieve acute pain.
- Complete efforts in the investigation of the chemical properties of a hibernation factor. A factor isolated from hibernating squirrel serum has demonstrated the ability to protect cells from ischemic injury

- **Casualty Prevention**

Initiate:
- Initiate effort to develop salivary tests for disease, toxin, allergen, and agent exposure and to determine immunization status. Particular emphasis is placed on salivary tests to assess immune status to the anthrax vaccine.

Continue:
- Continue development of technologies for enhanced body protection against battlefield munitions.
- Continue development of an improved aircrew protection suit for operational aircraft.
- Continue Rapid Detection and Response for Chem/bio Defense Systems program.

Complete:
- Complete effort to evaluate malaria DNA vaccine gene sequences for protective efficacy.

- **Undersea Medicine**

Initiate:
- Initiate studies to develop methods for the non-invasive detection of bubbles in tissue and blood for improved diagnostics of decompression sickness. Current diagnosis of decompression sickness must rely on the presentation of outward symptoms that may not be manifest for several hours after the dive. The development of technology to detect nitrogen bubbles immediately after a dive will go a long way in identifying likely causes of decompression sickness and thus permitting treatment before major injury occurs.
- Initiate development of a treatment for decompression sickness using perfluorocarbon-based compounds. Artificial blood substitutes which utilize perfluorocarbon molecules to transport oxygen can also increase nitrogen transport in the body and thus may provide a new treatment for preventing decompression sickness after diving.

Continue:
- Continue effort to assess the impact of thermal (i.e., heat and cold) stress on operational performance in Navy and Marine Corps personnel.
- Continue the development of predictive measures for oxygen-induced seizures in the hope that a physiologically-based "early warning system" can be engineered to warn divers using hyperbaric oxygen of the impending likelihood of central nervous system seizures.
- Continue efforts to develop prophylactic agents to prevent hyperbaric oxygen toxicity in Navy and Marine Corps divers breathing pure oxygen at depth.
- Continue the development of novel agents that prevent the neurological damage associated with decompression sickness in Navy divers.

Complete:
- Complete studies to evaluate immunological function during harsh operational conditions.

- **Healthy and Fit Force**

Continue:
- Continue building on research into the underlying processes for cellular repair, applied research into the regeneration of auditory and vestibular hair cells in the inner ear.
- Continue exploring accident trends aboard reduced-crewed and high performance vessels such as fast boats, smart ships and next generation aircraft carriers to determine new approaches to reduce injury through improved design of workstations, seats, and controls.
- Continue to evaluate ways to protect hearing and balance through new protective systems.

FY 2004 PLANS

- **Casualty Care and Management**

Continue:
- Continue efforts in the development of a hemoglobin substitute.
- Continue the evaluation of the effects of a colloidal resuscitation fluid on brain injury.
- Continue studies to assess the energy status of various organs following resuscitation with standard crystalloids.
- Continue the evaluation of glycopeptide pain drugs.
- Continue the development of a casualty management tool for Operational Maneuver from the Sea (OMFTS) and special operations.
- Continue the evaluation of the effects of a hemoglobin red cell substitute on brain injury.
- Continue studies on the effects of Food and Drug Administration (FDA)-approved resuscitation fluids on the inflammatory response.
- Continue applied research on extending the circulation time of the gas diffusion enhancer, trans-sodium crocetinate (TSC).
- Continue the evaluation in models of hemorrhage combined with head trauma of arginine supplementation of hypertonic saline resuscitation fluid.
- Continue the evaluation of the control of systemic inflammation by the cytokine, IL-11.
- Continue studies in the evaluation of the trauma applications of hand-held ultrasound diagnostic instruments in the field.

- Continue a project to evaluate the use of heart rate variability (HRV) as a predictor of survivability of casualties. This effort has direct implications on the assignment of limited resources for evacuation of casualties.
- Continue a study evaluating the efficacy of a DHEA analog (Androstenetriol; AET) to decrease mortality and morbidity of battlefield casualties.
- Continue a study to evaluate the effectiveness of sublingual PC02 measurements to predict the onset of shock in patients. This method/device may improve management of casualties in shock due to trauma/hemorrhage.

Complete:
- Complete applied research on extending the circulation time of the gas diffusion enhancer, trans-sodium crocetinate (TSC).

- **Casualty Prevention**

Initiate:
- Initiate effort to apply novel DNA technologies to protect warfighters with immune system enhancers from environmental agents, endemic and infectious diseases with reduced logistic requirements and enhanced efficacy against multiple pathogens.

Continue:
- Continue effort to develop salivary tests for disease, toxin, allergen, and agent exposure and to determine immunization status.
- Continue development of technologies for enhanced body protection against battlefield munitions.
- Continue development of an improved aircrew protection suit for operational aircraft.
- Continue Rapid Detection and Response for Chem/bio Defense Systems program.

- **Undersea Medicine**

Continue:
- Continue studies to develop methods for the non-invasive detection of bubbles in tissue and blood for improved diagnostics of decompression sickness. Current diagnosis of decompression sickness must rely on the presentation of outward symptoms that may not be manifest for several hours after the dive. The development of technology to detect nitrogen bubbles immediately after a dive will go a long way in identifying likely causes of decompression sickness and thus permitting treatment before major injury occurs.
- Continue development of a treatment for decompression sickness using perfluorocarbon-based compounds. Artificial blood substitutes which utilize perfluorocarbon molecules to transport oxygen can also increase

nitrogen transport in the body and thus may provide a new treatment for preventing decompression sickness after diving.
- Continue effort to assess the impact of thermal (i.e., heat and cold) stress on operational performance in Navy and Marine Corps personnel.
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- Continue the development of novel agents that prevent the neurological damage associated with decompression sickness in Navy divers.

Complete:
- Complete the development of predictive measures for oxygen-induced seizures in the hope that a physiologically-based "early warning system" can be engineered to warn divers using hyperbaric oxygen of the impending likelihood of central nervous system seizures.

- **Healthy and Fit Force**

Continue:
- Continue building on research into the underlying processes for cellular repair, applied research into the regeneration of auditory and vestibular hair cells in the inner ear.
- Continue exploring accident trends aboard reduced-crewed and high performance vessels such as fast boats, smart ships and next generation aircraft carriers to determine new approaches to reduce injury through improved design of workstations, seats, and controls.
- Continue to evaluate ways to protect hearing and balance through new protective systems.

FY 2005 PLANS

- **Casualty Care and Management**

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- Continue to evaluate ways to protect hearing and balance through new protective systems.

	FY 02	FY 03	FY 04	FY 05
Environmental Quality	2,629	2,534	3,162	3,686

Environmental Quality (EQ) technologies enable sustained world-wide Navy operations, in compliance with all local, state, regional, national and international laws, regulations and agreements. This topic addresses the Navy Transformational Roadmap in the area of Sea Basing, Sea Strike and Sea Warrior. Compliant operations enable training evolutions and exercises that are critical for maintaining readiness. Technology development in this area supports the Chief of Naval Operations (CNO) prioritized Navy Science and Technology (S&T) requirements and leads to systems and processes that provide the Fleet with environmentally compliant forward presence, ashore and afloat. Specifically, this area supports requirements to minimize the curtailment of military operations due to ship, shore and aircraft compulsory compliance with national and international environmental regulations, and to sustain Naval forces anywhere in a timely and environmentally compliant manner.

FY 2002 ACCOMPLISHMENTS

Initiated:

- Initiated air and noise pollutant emissions control and treatment technologies for Navy platforms and assets. Air and noise emissions from existing aircraft do not meet local noise ordnances and air emission requirements and thus limit essential training at shore-based facilities. New technology will reduce or eliminate emissions to meet regulatory levels and ensure continued training and readiness.
- Initiated development of advanced environmentally compliant antifouling (AF) hull coatings for ships and submarines and compliant anticorrosion (AC) coatings for ship and submarine structures. Hydrodynamic performance testing of existing and emerging coatings for durability was initiated. New materials will be non-toxic while preventing hull fouling and vessel structure corrosion.
- Initiated advanced ship and submarine liquid, air, solid emissions control technologies. These will provide compliance with Uniform National Discharge Standards (UNDS) and Marine Pollution Convention/International Maritime Organization (MARPOL/IMO). Pending discharge regulations will limit the ability of Navy ships to sail in any body of water. New control technologies will enable the Fleet with unrestricted access to all water bodies in compliance with all regulations.
- Initiated automated underwater hull paint removal and application technology to eliminate hazardous waste discharges and enable continued in-water hull maintenance and repair operations in compliance with water quality regulations and avoid costly dry-docking.
- Initiated Navy ship ballast water exchange efficacy evaluation for non-indigenous species threat mitigation in order to validate the Navy's current double ballast exchange policy.

Continued:

- Continued and expanded the capabilities of environmentally compliant marine coatings test facilities that support the field-testing of new, improved, non-toxic antifouling coatings and systems for ships and submarine hulls.
- Continued shipboard non-oily wastewater bioreactor treatment system process controller development.

Completed:

- Completed copper sensor technology for Navy IWTP and appliqué technology for ship hulls and structures. This technology will enable the continued use of in-water cleaning of ship hulls while monitoring copper discharges to comply with regulations and will allow Navy Industrial Wastewater Treatment Plants (IWTPs) to cost effectively monitor copper in their regulated discharges; transition to NAVFAC and NAVSEA respectively (PE 0603721N).
- Completed metal hydride battery technology for lighter, more reliable and environmentally acceptable batteries for aircraft and systems; transition to NAVAIR, PMA 251.
- Completed automated dry dock ship paint application, overspray control, collection and treatment technologies to enable adherence to environmental laws and regulations in dry-dock operations, increased productivity and

reduced cost of compliance; transition to NAVSEA 04 (PE 0603721N), Manufacturing Technology (MANTECH) and NAVFAC (CHE).
- Completed identification of Navy air operations pollution control technology initiatives in order to enable continued critical depot maintenance activities while complying with environmental regulations; transition to SYSCOM/CNO Environmental Quality RDT&E Working Group (EQRWG) for prioritization.

FY 2003 PLANS:

Initiate:
- Initiate testing of several promising membranes that have been developed in the basic research EQ program. Membranes will be scaled up and optimized using cross flow testing. These membranes are expected to provide higher fluxes and reduced fouling for treatment of both gray water and oily water streams as well as for use as pretreatment microfiltration membranes for reverse osmosis (RO) desalination and water treatment systems.
- Initiate advanced ship wastewater bioreactor technology to optimize non-oily wastewater bioreactor efficiency and thus reduce size and weight, provide the capability for treating other liquid waste streams (oily) and to develop quick bioreactor start-up products (reduce start-up time by 50%).
- Initiate development of improved, "hardened" configuration of copper biosensor for use in underwater hull cleaning and dry-dock operations

Continue:
- Continue environmentally compliant marine coating test facilities support.
- Continue air and noise pollutant emissions control/treatment technologies for Navy platforms and assets.
- Continue advanced development of environmentally compliant antifouling (AF) hull coatings for ships and submarines and compliant anticorrosion (AC) coatings for ship and submarine structures.
- Continue advanced development of ship and submarine liquid, air, solid, emissions control technology.
- Continue automated underwater hull paint removal and application technology development.
- Continue Navy ship ballast water exchange efficacy evaluation for non-indigenous species threat mitigation.

Complete:
- Complete shipboard non-oily wastewater bioreactor treatment system process controller development; transfer to NAVSEA (PE 0603721N).

FY 2004 PLANS:

Initiate:

- Initiate advanced far-term noise and air pollution emissions abatement technology for future Navy platforms to enable unrestricted operations and training while complying with environmental laws and regulations and to reduce costly back-fit scenarios.
- Initiate testing of aqueous film forming foams (AFFF) developed and transitioned from related basic research activities to replace the existing formulations containing PFOS (perfluoro octanyl sulfonates) which have been shown to bioaccumulate and cause adverse environmental and human health effects.

Continue:

- Continue environmentally compliant marine coating test facilities support.
- Continue air and noise pollutant emissions control/treatment technologies for Navy platforms and assets.
- Continue advanced development of environmentally compliant antifouling (AF) hull coatings for ships and submarines and compliant anticorrosion (AC) coatings for ship and submarine structures.
- Continue advanced development of ship and submarine liquid, air, solid, emissions control technology.
- Continue automated underwater hull paint removal and application technology development.

Complete:

- Complete Navy ship ballast water exchange efficacy evaluation for non-indigenous species threat mitigation; transfer results to NAVSEA UNDS program.
- Complete testing and initial evaluation of novel membranes; determine remaining S&T issues and transition to NAVSEA.
- Complete advanced ship wastewater bioreactor technology to optimize non-oily wastewater bioreactor efficiency; Transition technology to NAVSEA 05MR, PE 0603721N.
- Complete development of improved, “hardened” configuration of copper biosensor for use in underwater hull cleaning and drydock operations; transition to NAVFAC (CHE) and to NAVSEA, 05M3, PE 0603721N.

FY 2005 PLANS:

Initiate:

- Initiate advanced environmental protection sensor and system control technology for future Navy platforms to enable more efficient system operation and to decrease manpower requirements for monitoring, diagnostics and repair evolutions.
- Initiate development and evaluation of microwave technologies for an RF plasma torch for use in advanced shipboard waste destruction processes. This will eliminate the use of consumed electrodes currently used in these systems reducing manpower/maintenance requirements.

Continue:

- Continue environmentally compliant marine coating test facility support.
- Continue air and noise pollutant emissions control/treatment technologies for Navy platforms and assets.

- Continue advanced development of environmentally compliant antifouling (AF) hull coatings for ships and submarines and compliant anticorrosion (AC) coatings for ship and submarine structures.
- Continue advanced development of ship and submarine liquid, air, solid, emissions control technology.
- Continue automated underwater hull paint removal and application technology.
- Continue advanced far-term noise and air pollution emissions abatement technology for future Navy platforms.
- Continue testing of aqueous film forming foams (AFFF) developed and transitioned from related basic research activities to replace the existing formulations containing PFOS.

	FY 02	FY 03	FY 04	FY 05
Biocentric Technologies	2,049	1,974	1,265	1,474

Biocentric technologies provide novel solutions for naval needs based upon the applications of biosensors, biomaterials, and bioprocesses. This program brings the power of modern biotechnology methods to bear on naval problems and reduces the technical risk associated with basic research advances by conducting demo-centric technology development programs. 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 2002 ACCOMPLISHMENTS

Initiated:
- Scaled-up and determined yield optimization of green synthesis of energetic materials using enzymes toward an environmentally acceptable production method for energetic materials without the use of hazardous reagents and generation of hazardous by-products.
- Evaluated whether sensors for trinitrotoluene (TNT) and other explosives can be used as autonomous underwater vehicle payloads for detection of unexploded ordnance (UXO).
- Initiated feasibility of energy harvesting benthic fuel cells using bioelectrochemical mechanisms at the water-sediment interface. The goal is to use naturally occurring microbes to harvest low levels of power (~0.1 Watt) on a continuous basis.
- Evaluated applicability of chemical sensing from autonomous underwater vehicles for Special Forces applications.

Continued:
- Continued, within the Chemical Sensing in the Marine Environment Program, efforts for locating the source of chemical plumes in very shallow waters using sensors on autonomous underwater vehicles. This will provide the

Navy with a new capability for the difficult task of remotely identifying unexploded ordnance (UXO) in the littoral zone.

- Continued, within the Chemical Sensing in the Marine Environment Program, efforts to characterize chemical plume structure in the very shallow water regime. Previous research indicates that the plume structure is quite variable and heavily dependent on environmental conditions and interactions. Mapping of plume structure under various environmental scenarios is necessary to guide the development of sensor systems for underwater UXO detection.
- Continued development of novel biosensors for explosives for underwater applications. These novel biosensor systems will provide sensitive, selective, and rapid detection of explosive signatures (such as TNT), a capability that the Navy currently lacks.

Completed:

- Completed and transitioned the metallized lipid tubule materials for radar absorbing and antenna isolation applications. These materials show potential as replacement for the existing systems now used for this purpose, displaying competitive absorption properties but weighing approximately 60% less, a very important advantage on the small decoy vehicles on which they are deployed.
- Completed investigation of bio-molecular barcodes for unique identification and tracing of materials. These barcodes or taggants act as microscopic markers that can be used to trace and identify material of naval interests, e.g., military equipment and personnel, and which have high applicability for counter-terrorism programs.
- Completed, within the Chemical Sensing in the Marine Environment Program, efforts to characterize the source strengths of underwater unexploded ordnance. Distance from source and associated concentration profile data will drive the operational requirements necessary to guide the development of sensor systems for underwater UXO detection.

FY 2003 PLANS:

Initiate:

- Initiate development of stochastic chemical sensors for naval applications to provide single molecule detection.

Continue:

- Continue the development of novel biosensors for detection of explosives underwater
- Continue green synthesis of energetic materials using enzymatic catalyst
- Continue the development and integration of sensors for explosive compounds on Autonomous Underwater Vehicles for underwater applications
- Proceed with energy harvesting benthic fuel cells based on microorganisms

Complete:

- Complete work on locating chemical plume source in very shallow waters using sensors on Autonomous Underwater Vehicles
- Complete the characterization of chemical plume structure in very shallow waters

FY 2004 PLANS:

Initiate:
- Initiate the development of reagentless sensors for Weapons of Mass Destruction.

Continue:
- Continue the development of stochastic chemical sensors for naval applications to provide single molecule detection.

FY 2005 PLANS:

Initiate:
- Initiate the development of novel biomimetic propulsion systems for autonomous underwater vehicles.

Continue:
- Continue the design and development of reagentless sensors for Weapons of Mass Destruction.

Complete:
- Complete the development of stochastic chemical sensors for naval applications to provide single molecule detection.

CONGRESSIONAL PLUS-UPS:

	FY 02	FY 03
3-Dimensional Printing Metalworking Project	*	3,765

The system would incorporate a Three Dimensional Printing (3DP) machine and supporting process equipment. Three Dimensional Printing is a rapid solid freeform process for metal and metal composite parts and tooling. This new technology has been under development at MIT and is an additive manufacturing technology that allows the creation of a component from a computer aided design (CAD) model circumventing the limitations imposed by conventional material removal techniques. The project includes working to define, develop and demonstrate the system and 3DP process on specific DOD and DLA applications. This project will advance the potential use of the 3DP process and its unique capabilities for the manufacture of components in an e-manufacturing environment. (*Appropriated in FY02 in PE 0602123N, $2,401)

Advanced Fouling and Corrosion Control Coatings	FY 02	FY 03
	*	4,793

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. (*Appropriated FY02 in PE 0602234N, $3,366)

	FY 02	FY 03
Advanced Fuel Additive Pilot	1,644	*

Efforts focus on conducting a pilot demonstration on a Navy diesel platform of alcohol fuel additives blended into diesel fuels. (*Appropriated FY03 in PE 0602234N, $1,662)

	FY 02	FY 03
Advanced Materials and Intelligent Processing	1,452	1,467

Materials applied research is conducted to develop the resin molding process utilizing both sensor and model based approaches. These new materials will provide the Navy the capability to produce battle damage resistant aircraft with improved stealth characteristics.

	FY 02	FY 03
Advanced Safety Tether Operation	965	0

This effort develops tether technology to provide reliable and controlled boost and de-boost of spacecraft. The FY02 tasks are: 1. Establish system requirements for operational and demonstration systems, 2. Conduct tether dynamics simulations, 3. Develop concepts for attaching objects to a tether in deployment, 4. Design and test prototype tether systems.

	FY 02	FY 03
Agile Vaccinology	8,264	3,913

Investigations are conducted on modern vaccine technologies, including DNA-based vaccines. An example is the malaria DNA vaccine where efforts focus on the optimal vaccination strategy in mice and on determining whether the best co-vaccination strategy is a protein antigen delivered by a viral vector or by a replicon system.

	FY 02	FY 03
Automated Diode Array Manufacturing	2,498	2,444

Efforts include applied research 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 02	FY 03
Battlespace Information Display Technology (BIDT)	3,266	*

This project established a state-of-the-art battlespace visualization environment to advance Joint Vision 2020 objectives and the United States Navy's "Forward from the Sea" strategy. BIDT integrates commercial technologies with emerging Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) capabilities, specifically for Navy and Marine Corps battlefield commanders and their staffs. In the absence of proven data correlation and information fusion algorithms, BIDT visually represents the positions and tracks of ships, aircraft, and ground-based units, along with threat envelopes - in a whole earth, scalable, multi-resolution virtual display linked to intelligence and operational databases. Therefore, BIDT presents the commander with the battlespace that closely approximates what one sees in their "mind's eye." This realization of the mind's-eye view is expected to result in intuitive actions that transform the 2-D battlespace into a 4-D battlespace so that the warfighter can view events in near-real time and fold in operational aspects associated with time - the 4^{th} dimension. Successful integration and evaluation in this effort will facilitate the production and approval of formal acquisition documentation for the Navy. (*Appropriated in FY03 in PE 0602234N, $2,055)

	FY 02	FY 03
Bio-Detection Surveillance System	0	*

This effort is to develop technologies for rapid detection, identification, and surveillance of a wide range of pathogenic organisms and toxins. The project will support the development of the immunological DNA amplification based detection system with covalent conjugation of the DNA that will allow rapid detection time

appropriate for response to biological weapons and for antiterrorism applications. (*Appropriated FY03 in PE 0602233N, $1,027)

	FY 02	FY 03
Biodegradable Polymers for Naval Applications	0	977

Three approaches are being studied in this program. First, natural polymers based on filled soybean protein/vegetable oil derivatives have been developed for possible use in a chaff cartridge with biodegradation measurements at Natick. In a second project, polylactic acid/cellulose acetate blends are being made with optimal tradeoffs between softening point and biodegradability. Finally, novel exfoliated clay reinforcements are being developed which should provide physical and thermal reinforcement and a mechanism to encourage biodegradation in high salt environments.

	FY 02	FY 03
Bioenvironmental Hazards Research Program	961	1,173

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 02	FY 03
Carbon Foam for Navy Applications	*	439

This effort develops carbon foam materials for Navy use. These advanced materials will have significantly improved mechanical, thermal, and fire resistant properties that will permit their use in man-rated areas aboard ships and submarines. (*Appropriated FY02 in PE 0602234N, $2,509)

	FY 02	FY 03
Ceramic and Carbon Based Materials	0	977

This effort is developing ceramic and carbon based materials to reduce cost of propulsion systems and heat shields. The effort is 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 02	FY 03
Characterization of Novel Materials	0	2,738

This effort will support the development and optimization of materials for the electromechanical gun system. Specifically, efforts focus on the characterization of mechanical and thermal properties under shock loading for candidate electromechanical (EM) gun barrel, projectile and target materials. This includes the characterization of the parameters necessary to optimize next generation reactive materials for gun projectiles and electrode materials for enhanced performance, next generation solid-oxide fuel cells. Predictive computer

models will be developed that incorporate these material properties to optimize weapon systems for performance and lethality. These capabilities can additionally be used to evaluate the performance and survivability of on-board microelectronic systems for use in projectile guidance systems or for assessing the mechanical and thermal states of projectiles during the launch-to-target sequence. This capability will guide the development of materials optimized for use in EM gun launchers and hypervelocity projectiles that can be validated with these predictive capabilities. The combined research program in the dynamic response of materials and electromagnetic launching will result in the capability to develop superior bore materials for EM launchers and the evaluation of ballistic projectiles and on-board projectile electronic systems under the extreme acceleration conditions characteristic of these weapons.

	FY 02	FY 03
Combinatorial Materials Synthesis	2,019	0

This work explores combinatorial methods to provide a basis for the development of advanced materials.

	FY 02	FY 03
Fibrous Monolithic Materials Insertion	0	2,200

This effort is developing 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 02	FY 03
Formable Aligned Carbon Thermo Sets (FACTS)	1,442	977

This effort advances formable aligned carbon thermosets (FACTS) (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 (weight penalties), expensive, and subject to corrosion. Currently, composite materials (continuous fibers) cannot produce low cost, complex parts, and other attempts to address this problem (resin transfer molding and vacuum assisted resin transfer molding) have produced expensive and sometimes poor quality parts.

	FY 02	FY 03
Human Systems Technology	0	977

Extend the scientific basis of human centered display and interfaces with the goal of enabling non-pilot operators to successfully operate unmanned combat air vehicles (UCAVs); perform psychophysical studies of combining tactile interfaces (based on previous networking research) designed for sensory substitution (e.g. sight) and for sensory augmentation in complex dynamic environments such as aviation; and continue to develop

two classes of advanced Boolean algorithms that support solutions to practical problems (e.g. scheduling, cryptography, network design).

	FY 02	FY 03
Improved Performance Integration Tool (IMPRINT) Modeling	0	1,027

Enhances an Army-developed system called IMPRINT to be used in support of human factors engineering in Navy applications. In its current form, IMPRINT is focused on systems and platforms of Army scale (e.g., tanks, helos), not on a Navy Scale (e.g., ships). A major part of the FY03 effort is to scale up the IMPRINT modeling technique for application in the human factors and manning requirements for the larger Navy platforms.

	FY 02	FY 03
Marine Mammal Research	1,066	977

This work includes applied research related to marine mammals.

	FY02	FY03
Modeling, Simulation and Training Immersion Facility	961	0

Develop the prototyping of faster, less expensive, and more robust virtual and augmented reality systems for the military at this facility. Develop innovative software and hardware components for virtual and augmented reality simulations. Test and evaluate the effectiveness of these new virtual and augmented reality approaches using specific applications. Potential applications include computer graphics and associated display technologies to be used in various military systems; emerging haptic technologies to be used in military tactical training systems or medical trainers; and new systems for locomotion in virtual environments (including computing platforms and networks that facilitate locomotion).

	FY 02	FY 03
National UUV Test and Evaluation Center	0	4,596

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 02	FY 03
Printed Wiring Boards	1,633	*

This work will focus on CAD/CAM (computer aided design and manufacturing) of advanced printed wiring boards (PWB). The technologies are (a) laser ablation and metallization, (b) high velocity particle consolidation of metal powders (HVPC), and (c) acoustic microscopy for PWB that will revolutionize PWB manufacturing and reverse engineering for Naval Systems. Special consideration will be given for compatibility with organic semiconductor electronics. (*Appropriated in FY03 in PE 0602234N, $3,325)

Rapid Detection and Response for Chem/Bio Defense Systems	FY 02	FY 03
	0	977

This effort will focus on the development of technologies for rapid detection of, and response to, airborne biological and chemical agents in battlefield and key urban environments. This work will support the development of antibody-based and DNA-based detection systems in a ChemArray Chip (impedance imaging sensing system) as a flow-through reusable sensor. In addition, this work will develop necessary data and models to be used to predict the proper placement of real-time sensors in indoor environments for antiterrorism applications.

	FY 02	FY 03
Rhode Island Disaster Initiative	1,442	1,173

This effort includes technologies and techniques to determine effective solutions for medical disaster response. In particular, this effort focuses on handling mass casualties that would occur from natural disasters, terrorist acts such as the USS Cole, and both military and civilian casualties produced by weapons of mass destruction.

	FY 02	FY 03
Titanium Matrix Composites Program	2,498	2,162

Titanium metal matrix composites are developed 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 use of titanium metal matrix composites will also allow high payoff applications in future engine compressor systems where extreme stiffness and strength requirements at elevated temperatures now require the use of significantly heavier superalloys and titanium. 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 02	FY 03

Virtual Company Distributed Manufacturing	1,057	*

This effort will continue and expand ongoing applied research of the West Virginia High-Technology Consortium Foundation, sponsored by plus-ups in FY 1997 and 2001. The purpose of the work is to establish a network of commercial businesses in the greater West Virginia economic region which are linked by updated, interoperable computer networks and databases, and supported through partnerships with government agencies and private suppliers and buyers of technology. This network will facilitate the flow of new technology among naval, other government, and commercial applications, and thereby foster robust businesses in the region. The Department of the Navy's goal is to reduce the total ownership cost of naval systems by increasing the availability of affordable new technologies through increased commercial activity and use of technologies developed primarily for the commercial marketplace. Work in FY2002 focused on applications of business portals, webcrawling and websearch engines, database access tools, intercompany partnerships, and development of a self-sustaining organization. The program complemented similar efforts in other regions, including for instance the "Hubs" initiative in Delaware, Maryland, New Jersey and Pennsylvania. (*Appropriated in FY03 in PE 0602234N, $1,761)

	FY 02	FY 03
Visualization of Technical Information	1,639	1,662

This effort includes applied research related to enhancing the visualization of technical information. Technology emphasis is on intelligent agent technologies, applied to the understanding and presentation of the readiness status of a shipboard integrated logistics information system. Weapons platforms, shipboard engine health, and other critical sustainment to the battlegroup readiness posture are assessed and disseminated via the intelligent agent community.

	FY 02	FY 03
Wire Chaffing Detection Technology	1,348	*

This effort develops advanced technologies (sensors, electronics, and algorithms) for aircraft wiring diagnostics. The project will provide the Navy a means of rapid detection of faults in wiring and enable rapid, efficient maintenance. (Appropriated in FY03 PE 0603236N, $1,368)

	FY 02	FY 03
Wood Composite Technology	2,029	0

This effort develops advanced-engineered lumber for application in Navy piers and wharves and other shore infrastructure including office space and military housing. These low cost composites will exhibit extreme resistance to environmental degradation thus greatly reducing maintenance costs.

	FY 02	FY 03

ADPICAS	*	0

The ADPICAS (Adaptive Damping and Positioning Using Intelligent Composite Active Structures) effort modifies and refines the designs of active structural components such as composite struts and composite panels. It also explores and tests the integration of these components into systems. (*Appropriated FY02 in PE 0602234N, $1,251)

	FY 02	FY 03
Maritime Fire Training/Barbers Point	*	0

Environmental studies are conducted in preparation for efforts at Barber's Point, HI, to build a firefighting training facility. This research tool will merge the real and virtual worlds to create an environment that can provide cost-effective realism without the dangers created by real fires. In addition, this trainer will enable firefighters to maintain their proficiency while being responsive to increasing environmental constraints related to smoke and water additives released into the atmosphere. (*Appropriated FY02 in PE 0602233N, $2,498)

	FY 02	FY 03
Materials Micronization Technology	*	0

This effort is developing advance grinding processes that can produce ultra fine particles at high production rates and with very little contamination from the grinding media. Such particles will be used as feed materials to manufacture high quality electronic components at a low cost. Other applications will include manufacture of light weight, low cost, structural composites with multifunctional characteristics for future jet fighters. (*Appropriated FY02 in PE 0602234N, $3,379)

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 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 0601103D8Z University Research Initiatives
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 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602271N
PROGRAM ELEMENT TITLE: RF Systems Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
RF Systems Applied Research	58,922	74,208	44,019	51,415	54,418	54,265	55,245	56,255

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 the PE, the programs described herein are representative of the work included in the PE.

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission	68,300	56,263	57,974	57,702
Adjustments from FY 2003 President's Budget:				
Congressional Plus-Ups		19,700		
SBIR Reduction	-1,276			
Execution Adjustments	-7,771			
Congressional Rescissions/Adjustments/Undistributed Reductions	-331	-950		
S&T Program Adjustments			-12,412	-4,950
NWCF Rate Adjustments			-362	-42
Efficiencies at NWCF Activities			-166	-186
Pay Raise/Inflation Adjustments		-805	-1,015	-1,109
FY 2004/2005 President's Budget Submission	58,922	74,208	44,019	51,415

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602271N
PROGRAM ELEMENT TITLE: RF Systems Applied Research

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not Applicable.
Technical: Not Applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602271N Project Title: RF Systems Applied Research
PROGRAM ELEMENT TITLE: RF Systems Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
RF Systems Applied Research	58,922	74,208	44,019	51,415	54,418	54,265	55,245	56,255

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 02	FY 03	FY 04	FY 05
Surveillance Technology	11,144	7,723	5,689	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 2002 Accomplishments:
Developed design and system concepts for an Ultra High Frequency (UHF) Electronically Steered Array antenna applicable to the E-2C airborne early warning aircraft. Developed design and system concepts to guide development of a Data Distribution Module (DDM) based on commercial off the shelf (COTS) technology for the Common Affordable Radar Processor (CARP). The DDM will enable Naval radar system processors to be designed for COTS utilization and to be affordably up-graded by insertion of commercial processors, Information Protocols, and standards as the technology advances. Conducted a technology assessment and a study to determine availability and utility of Non-Cooperative Target Recognition (NCTR) techniques for long range all weather target identification. High-confidence, long range, all aspect, NCTR capability is an identified enabling capability for Missile Defense, Fleet Force Protection, and Time Critical Strike Future Naval Capability (FNC) programs. Support for the AN/APY-6 project continued with development of advanced modes and signal processing techniques for maritime situational awareness.

The effort also continued with high performance radar detection, discrimination and identification of stationary and moving surface sea and land targets. Continued development of the Horizon Extension Sensor System (HESS) with emphasis on technologies including high power, wide band, efficient amplifiers, advanced cooling and digital beam forming for electronically steered, light weight, radar arrays to enable beyond-the-horizon surveillance of low flying targets from surface combatants. It is expected that detection range increases of 3X/4X with corresponding increases in reaction time may be achievable. Studied Digital Array Radar (DAR) architectures including wideband digital beam-forming techniques, which enabled rapid steering and precision control of multiple radar beams. DAR technologies are identified in the Surface Navy Radar Roadmap as critical system enablers for planned Theater Air and Missile Defense radar developments. DAR is also identified as critical elements in Program Executive Office - Theater Surface Combatant (PEO-TSC), Naval Sea Systems Command high power S-band radar system development for application to future surface combatant platforms.

FY 2003 Plans:
Continue development of 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. Continue development of advanced modes and signal processing for maritime situational awareness. Expand the study of NCTR technology to encompass harbor (short range) as well as long range all weather target identification. Continue the development of component prototyping relative to the Horizon Extension Sensor System (HESS) with emphasis on technologies for light weight arrays and high power Radio Frequency (RF) transmit/receive front-ends that can be made integral to multi-element electronically steered arrays for deployment from surface combatants. Continue integration of the Data Distribution Module (DDM) and CARP by incorporating and evaluating the performance of multiple parallel DDMs integrated into a simulated multi-channel radar front end. Perform evaluation of the entire processing chain from the Analog to Digital converter through the distribution of commercial Internet Protocol (IP) format data into the common affordable radar processor architecture. Conduct demonstrations within the AN/APY-6 project, in conjunction with NAVAIR’s Hairy Buffalo test-bed aircraft, to enable performance assessment of the Inverse Synthetic Aperture Radar (ISAR) and micro-doppler modes against small ship targets in harbor areas and against slow moving and idling ground targets such as trucks, tanks and armored vehicles.

FY 2004 Plans:
Develop hardware to demonstrate advanced modes and signal processing for harbor situational awareness. Continue the development of DAR technology with hardware demonstrations at the element and sub-array levels. Demonstrate critical enabling high power amplifier technology capable of supporting the Horizon Extension Sensor System (HESS) prior to prototype development. Demonstrate synchronization of multiple DDMs with asynchronous network topologies to enable the CARP.

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 a representative harbor surveillance demonstration. Continue the HESS project integration of High Power Amplifier (HPA) and digital beamforming X-band sub-arrays.

	FY 02	FY 03	FY 04	FY 05
RF Electronic Warfare Technology	9,975	13,573	12,579	16,341

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 2002 Accomplishments:
Identified candidate grid countermeasure devices and station keeping platforms and outlined candidate tactical scenarios under the Expeditionary EW Grid for Surface Unit Defense effort. Effort enabled offboard devices to be coupled with existing Electronic Attack (EA) systems to deny surveillance, targeting and missile seeker radars the capability to acquire and track surface platforms. Designed and fabricated the 8-channel Application Specific Integrated Circuit (ASIC) for the Wideband EW Channelizer effort. Effort enabled the development of low cost, small size and low power channelizers for use in tactical applications such as unmanned aerial vehicles. Reviewed past EA effectiveness efforts in order to pick the best methodology for designing, building and testing the effects monitor under the Hard Kill (HK)/EW Techniques Development effort. Work completed under this effort ultimately increased survivability of U.S. Naval units. Completed lab demonstration of the near real-time signal processing frequency modulation continuous wave (FMCW) subsystem for the Electronic Support (ES) detection of Low Probability of Intercept (LPI) Periscope Detection Radar effort. Effort enabled U.S. Naval units to approach, enter and operate in denied areas by detecting the presence of LPI threat systems. Conducted hardware-in-the-loop (HIL) anechoic chamber experiments using Foreign Military Exploitation (FME) seekers to evaluate off-board countermeasures (OCM) device field tactics in the Network Centric Battleforce EW effort. Results of this work assisted tactical commanders in the formulation of coordinated EA defense strategies. Completed integration of amplitude-to-phase conversion layout with the developed ASIC chip for the Digital Imaging Architecture for Multiple Large Target Generation effort that can increase platform survivability in the presence of advanced surveillance systems. Completed successful flight testing of the Anguila precision location system that can greatly increase the overall situation awareness of both tactical and strategic planners while having no affect on tactical aircrew workload. Completed final testing of signal processing algorithms against Binary Phase Shift Keying (BPSK) and Linear Frequency Modulation (LFM) signals for the Next Generation Specific Emitter Identification (SEI) effort that

aids in platform discrimination and identification. Conducted synthetic sea clutter generic waveform chamber tests in the EA Techniques to Counter Advanced Threats effort. Developed and demonstrated advanced EA techniques to counter advanced radio frequency guided missiles that can significantly increase platform survivability.

FY 2003 Plans:
Continue determination of EA obscuration technique gain via HIL and simulation experiments in the Expeditionary EW Grid for Surface Unit Defense effort. Fabricate and test sub-channelizer and full channelizer ASIC's for the Wideband EW Channelizer effort. Simulate effectiveness predictions of various EA techniques against the Scout radar under the hardkill/electronic warfare (HK/EW) Techniques Development effort. Conduct field testing/demonstration of the near real-time signal processing FMCW subsystem for the ES detection of LPI Periscope Detection Radar effort. Perform field demonstrations of OCM device field tactics against FME seekers as part of the Network Centric Battleforce EW effort. Integrate the ASIC chip with the Advanced Multifunction Radio Frequency-Concept (AMRF-C) Digital Radio Frequency Memory (DRFM) sub-system for the Digital Imaging Architecture for Multiple Large Target Generation effort. Perform testing of coordinated coherent/non-coherent techniques under the EA Techniques to Counter Advanced Threats effort. The Advanced EA Waveforms effort will further test and evaluate advanced multi-level pseudo-random EA waveforms and develop and design other new concept EA waveforms. Conduct analysis of short-term stability of Inertial Navigation System (INS)/Global Positioning System (GPS) for doppler recovery, and perform data analysis for modeling clutter returns from a coherent source under the countermeasure for Wideband Antiship Threats effort. Conduct analysis and model development to verify the theoretical concept of a compact combined azimuth and elevation direction finding (DF) antenna under the Hybrid Interferometer Technology Development effort.

FY 2004 Plans:
Identify effective offboard grid configurations and associated network requirements under the Expeditionary EW Grid for Surface Unit Defense effort. Demonstrate full radio frequency-to-pulse descriptor word system functionality under the Wideband EW Channelizer effort. Perform study and lab testing that investigates the utility of coordinated NULKA/EA responses under the HK/EW Techniques Development effort. Conduct lab testing of the near real-time processing of the ultra-wideband chirp subsystem under the 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. The Advanced EA Waveforms effort will test and evaluate new EA waveforms and perform analysis of implementation requirements. Perform Electronic Countermeasure (ECM) systems analysis and modeling for both onboard and offboard systems under the countermeasures (CM) for Wideband Antiship Threats effort. Conduct analysis and modeling to develop and refine the detailed DF antenna design for the Hybrid Interferometer Technology Development effort.

FY 2005 Plans:
Perform field testing that investigates the utility of coordinated NULKA/EA responses under the HK/EW Techniques Development effort. 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 hardware and software implementation for fleet testing under the Advanced EA Waveforms 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.

	FY 02	FY 03	FY 04	FY 05
RF Communications Technology	8,096	8,319	4,236	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 2002 Accomplishments:
Developed system designs and concepts for an X/Ku band phased array antenna to provide surface combatants with improved Intelligence, Surveillance, and Reconnaissance (ISR) connectivity through the use of transmitting and receiving phased array antennas compatible with the shipboard environment. The X/Ku band antenna design facilitated wideband beyond line-of-sight connectivity to airborne relay assets via the Tactical Common Data Link (TCDL) in support of network centric warfare operations. Conducted investigations into K/Ka band phased array technologies, designs and concepts with emphasis on scalability of the array concepts and design to K/Ka/Q Band operations. Finalized initial design efforts for a Next Generation Buoyant Cable Antenna (NGBCA) which will specifically address Navy needs to provide submarines a multi-band buoyant cable antenna system capable of supporting network centric operations while operating at tactical depths and speed. The technology findings from this effort became the basis for development of an advanced technology demonstration antenna which supported the Knowledge Superiority and Assurance (KSA) Future Naval Capabilities (FNC) program. Conducted technology investigations to define a Naval Battle-force Network (NBN) architecture and system concept and to assess its technological feasibility. The designs included networking architectures that provided for integration of line-of-sight (LOS) wireless networks into the existing over-the-horizon (satellite-based) network and provided guidelines for development of a communications payload for Vertical Take-off Unmanned Air Vehicles (VTUAVs). The activity continued development of technologies that were previously (FY 2001 and prior) pursued within PE 0602232N. Specifically, efforts included the fabrication of demonstration hardware for an Ultra Small Aperture Terminal (USAT) K/Ka Band Phased Array that will provide a limited satellite communications capability for surface ships and moving ground vehicles. Multi-function communications apertures and architecture concepts were investigated and assessments of operational utility and benefit conducted. These technologies are planned for incorporation in designs of new communications systems and network architectures being developed within the Knowledge Superiority and Assurance Future Naval Capability program. Finalized system designs for a ship-based integrated very high frequency (VHF)/ultra high frequency (UHF)/L-Band (IVUL) antenna system that will consolidate antennas from those frequency bands into a single

configuration, thereby reducing topside space requirements while maintaining electromagnetic compatibility for legacy and future communications equipment. The co-site interference mitigation technology will permit multiple UHF systems to efficiently operate and co-exist on board the same surface platform. This effort successfully developed and demonstrated co-site interference mitigation technology that provides for dynamic range extension of receiving systems operating aboard ship. The Extremely Low Frequency (ELF) on-hull antenna technology successfully demonstrated that major acoustic noise sources that severely degrade ELF receiver performance can be eliminated. This technology is now available for insertion into ELF communications system product improvement programs and for insertion into programs pursuing development and acquisition of future ELF communications systems.

FY 2003 Plans:
Continue the X/Ku band phased array system design optimization and prepare a transition plan for development of an advanced technology demonstration unit under the KSA FNC in PE 0603271N. Continue development and characterization of a prototype K/Ka/Q band phased array with emphasis on simultaneous multi-beam operation across both frequency bands. This effort will be continued in FY 2004 and beyond in PE 0603271N. Demonstrations of the jointly (DARPA/ONR) developed Ultra Small Aperture Terminal (USAT) K/Ka Band Phased Array will be conducted aboard surface ships and moving ground vehicles. Perform final design for Next Generation Buoyant Cable Antenna and provide to the KSA FNC apertures program for advanced technology development within PE603271N. Continue development of the NBN architecture and technologies. The NBN development will incorporate the tactical communications payload for Vertical Take-Off Unmanned Air Vehicles (VTUAV) into the NBN architecture and will implement queuing management technology in Navy LOS networking radios. The queing management technology is expected to optimize end-to-end performance of mobile ad hoc wireless networks, augment the Quality of Service (QoS) strategy for the Automated Digital Network System (ADNS) and provide for protocol independent multicast routing over LOS networking radios. The NBN effort will also develop and publish a design document to guide development and testing of prototype networks prior to their integration in the Multi-Tactical Digital Information Link (TADIL) Processor. The design guide will also provide guidelines for selection of alternative protocols for ad hoc mobile wireless networking and for investigations into use of Internet Protocol QoS technology,and advanced routing and load distribution techniques to permit prioritization of mission critical information flows over congested Navy satellite links. Investigate
multi-function systems architectures and development of implementation techniques for incorporating high performance time critical communications functions such as Common Data Link (CDL), Tactical Common Data Link, and Defense Satellite Communication System (DSCS) capabilities into the Navy’s Advanced Multi-Function Radio Frequency Concept (AMRF-C) technology test bed.

FY 2004 Plans:
Development of the NBN technologies will continue with emphasis on system level integration and network demonstrations. The NBN efforts under this PE will transition to acquisition programs at Space and Naval Warfare Systems Command (SPAWAR) in this year. Continue development of methods and processes including standardized interfaces and Information Protocol (IP) standards 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.

FY 2005 Plans:
Integrate Common Data Link, Tactical Common Data Link and Defense Satellite Communication System functions into the Navy's AMRF-C technology test bed and develop resource management and control processes to maximize communication function performance while minimizing electromagnetic compatibility and interference issues with other functions such as Electronic Support (ES) and Electronic Attack (EA).

	FY 02	FY 03	FY 04	FY 05
RF Navigation Technology	1,928	2,054	2,285	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 2002 Accomplishments:
The High Dielectric Mini-Array Antenna effort completed extensive testing of an antenna that adaptively suppresses jammers by a null-steering approach. The antenna is being considered as a candidate for the next generation GPS Joint Program Office (JPO) Anti-jam (AJ) Antenna. The Miniature Controlled-Radiation-Pattern-Antenna (M-CRPA) effort used measured sensitivity patterns to confirm that the present configuration will allow not only earth-bound jamming signals to be suppressed but also clustered jammers to be suppressed. This performance will allow Navy aircraft to travel from carriers towards shore-based jammers and not be markedly affected. Determined that the Non-linear Array Antenna appears to be particularly effective if a jamming-field approach was employed by enemy forces. Algorithm development resulted in addressing initial implementation. The Digital Signal Processing (DSP) techniques under the Space Time Adaptive Processing (STAP) effort were determined to be implementable in an all-digital processing stage immediately following the receiver antenna array. Determined the techniques can be integrated into existing systems with minor impact on overall system architecture.

FY 2003 Plans:
Within the M-CRPA antenna effort, demonstrate an antenna, feed network and nulling electronics all integrated into a compact prototype unit. Within the Non-linear Array Antenna effort, develop a compact prototype antenna with adaptive, compact array elements, coupled-oscillators, and phase-locked-loop system (to null multiple jammers simultaneously) and demonstrate aspects of its expected unique performance. The Non-linear Array Antenna effort plans to demonstrate an array antenna with 20 to 35 elements in a 6-inch diameter that derives performance benefit from the significant mutual coupling of array elements that are inherent in close-spaced designs. Develop the Submarine Mast-Mounted Controlled Reception Pattern Antenna (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 will include computer modeling, brassboarding, and fabrication of the elements, the array, and the matching network to prove the concept. Digital Signal Processing techniques using Space Time Adaptive Processing (STAP) will

pursue a multistage architecture using nonlinear filtering methods for jammer-resistant code tracking. In addition, STAP and code tracking will be merged for improved timing acquisition in the presence of wideband jamming.

FY 2004 Plans:
STAP for GPS Antenna effort will continue with development of two of the best ranked techniques of those initially investigated. Implementation issues will continue to address concerns for computational speed and performance reliability. The Submarine Mast-mounted Controlled Reception Pattern Antenna (CRPA) for the Global Positioning System will undergo laboratory testing to determine the effectiveness of its nulling functions.

FY 2005 Plans:
STAP for GPS Antennas will be applied to one of the receiver-antenna systems developed in this program or to a system recommended by the GPS-Joint Program Office (GPS-JPO). Specific jammer types will be also addressed in this effort. The Submarine Mast-mounted Controlled Radiation Pattern Antenna will undergo field testing to determine if the laboratory performance can be achieved in a more realistic environment.

	FY 02	FY 03	FY 04	FY 05
RF Solid State Power Amplifiers	3,500	3,500	3,500	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 2002 Accomplishments:
The development of silicon carbide (SiC) bipolar junction transistors (BJTs), suitable for high radio frequency (RF) pulsed power generation at UHF-L band frequencies for application to naval airborne surveillance sytems, resulted in the first demonstration of a microwave SiC silicon carbide bipolar transistor and operated at 425 MHz with an output power of 50 watts per cell. Aluminum Gallium Nitride/Gallium Nitride (AlGaN/GaN) wide bandgap high electron mobility transistor (HEMT) technology for naval electronic warfare and surveillance system applications will provide the basis for demonstration of a 10 W amplifier with 45% power added efficiency at 35 GHz. Demonstrated AlGaN HEMTs operating at 28 Gigahertz (GHz) with a power density of > 5 watts per millimeter (W/mm) The design of ultra broadband, multi-octave, power amplifiers continued to be optimized for efficiency and packaged parts were tested for future application to highly versatile, multifunction systems with multiple simultaneous RF beams. Demonstrated record output power for the broadband operation achieved.

FY 2003 Plans:
Continue development of SiC bipolar transistors and extend their frequency of operation to L-band. Continue the development of MMW AlGaN/GaN wide bandgap HEMT technology with an emphasis on output signal quality and linearity.

Continue the 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. Continue development of the AlGaN HEMT broadband amplifiers for electronic warfare decoy applications.

FY 2004 Plans:
Continue development of SiC bipolar transistors and demonstrate 300 W of output power at L-band. Continue development of MMW AlGaN/GaN wide bandgap HEMTs with an emphasis on output signal quality and linearity. Develop advanced transistor materials and structures to enhance amplifier efficiency. Emphasis will 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 with an emphasis on output signal quality and linearity. Develop advanced transistor materials and structures to enhance amplifier efficiency and linearity. AlGaN HEMT broadband amplifiers will demonstrate over 20W output with flat output over the full band for electronic warfare decoys.

	FY 02	FY 03	FY 04	FY 05
RF Vacuum Electronics Power Amplifiers	6,500	4,500	4,500	4,500

Provides for the development of microwave (MW), millimeter wave (MMW), 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 2002 Accomplishments:
Designed experimental high dynamic range vacuum power booster using current analog standards of linearity and fabricated for use as a test vehicle to validate physics-based time-dependent codes and simplified communication-link models. This design effort addressed the need for improved amplifier models and vacuum power booster (VPB) designs that support increased dynamic range, phase linearity, and bandwidth requirements associated with multi-level, broadband digital signals needed by systems such as the Wideband Gapfiller System and the improved AN/WSC-6 shipboard terminal. Developed a basic time-dependent block model for modeling digital signals in helix Traveling Wave Tubes (TWTs). Ongoing efforts in industry to develop K_a-band Coupled Cavity Traveling Wave Tubes (CC-TWTs) for radar Patriot Advanced Capability (PAC-3) and communications applications are adversely affected by limitations in available circuit design capabilities. In response, the extension of GATOR, a multi-dimensional, large-signal code for coupled-cavity circuits, continued with the insertion of an improved alternating current (AC) space charge model. For computational simplicity, all current nonlinear circuit design codes operate in the frequency domain. Proper understanding of device physics relevant to amplification of the complex digital waveforms to be used in high data rate (HDR) communications will require the availability of codes operating in the time domain.

CHRISTINE1D, the 1-dimensional (1D) large signal circuit design code, was used interactively with HDR vacuum power booster (VPB) experiments to guide the development and validate the code. CHRISTINE1D v1.43 AND CHRISTINE3D v1.4 were released to industry for testing and validation. Tested telegrapher's equation solution for linear amplifiers (TESLA), the 2D klystron design code for single-beam configurations. The W-band gyro-klystron technology was integrated into the Naval Research Laboratory (NRL) Wideband Advanced Radar for Low Observable Control (WARLOC) radar, which has application to space object identification, and demonstrated 70 kW peak power output. The prototype K_a-band gyro-TWT, developed using a ceramic loaded circuit to obtain a 3% bandwidth, demonstrated a peak power performance of 137 kW, 47-dB gain, with a 1.1 GHz bandwidth. The 94-GHz gyro-twystron demonstration achieved peak power of 59 kW at a bandwidth of 1.5 GHz in low-duty testing. **Reliable (> 10^5 hrs), high current density (>10 A/cm^2) cathodes will be required for the development of the multiple beam klystrons needed for reduced noise improvement of shipboard radars.** Based on the success of the rhenium coating studies, the scandate emitter effort was extended to investigate the use of pulsed laser deposition (PLD) to tailor the emitting surface for uniformity, stability, and high current density.

FY 2003 Plans:
Continue high dynamic range VPB experiments to improve digital signal error performance with a goal of yielding a two-fold increase in power margin and data rates in excess of 1 Gbps by incorporating memory effects into the time-dependent block model for helix TWTs. With a focus on multi-beam amplifiers, investigate the "cold" bandwidth capabilities of a multi-gap klystron with eight electron beams and design broadband input and output waveguides for such cavities. Two-dimensional/three dimensional (2D/3D) CC-TWT design code development continues with the addition of a model to handle reflections at internal matching elements. 3D models for alternating current (AC) space charge for both helix and coupled-cavity TWTs will be developed, as will a hybrid mesh capability (hexahedra and tetrahedra) for MICHELLE. A 3D stability analysis for helix TWT design codes will be developed. Continuing the investigation of high-brightness scandate cathodes using PLD techniques, the optimum chemical composition required for high-current-density scandate emission will be investigated.

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. Using TESLA, perform an RF optimization for multi-beam klystrons. Release to the U.S. vacuum electronics industry the large-signal time-dependent code GATOR incorporating the reflection models developed earlier for beta testing. Extend CHRISTINE3D development to incorporate a self-consistent model for background ion effects in the helix and subsequently release to the domestic vacuum electronics industry. Introduce automatic mesh refinement algorithms into the 3D Gun/Collector code MICHELLE. Release MICHELLE v3.0 and TESLA v2.0 to the domestic vacuum electronics industry for beta testing. Investigate mechanisms to replenish scandium to the surface of the electron emitter to support cathode longevity.

FY 2005 Plans:

Use two-and three-cavity narrow-band S-band multi-beam klystron experiments to validate the multi-beam design tools developed earlier. In order to reduce computational cycle times and improve predictive accuracy of the physics-based codes, develop algorithms suitable for parallelization in MICHELLE, the 3D Gun/Collector code. Develop similar parallelization techniques for TESLA as it is tailored for multiple-beam klystron development; both improved codes will be released to the domestic vacuum electronics industry. Demonstrate a high-data-rate (> 1 Gbps) TWT using 16 bit quadrature amplitude modulation (QAM). Transfer the technology for scandate cathode fabrication to the domestic vacuum electronics and cathode industries.

	FY 02	FY 03	FY 04	FY 05
Supporting Technologies	9,361	10,425	11,230	12,710

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 2002 Accomplishments:
Performed architectures studies to provide the basis for the design of octave bandwidth linearizers needed for use in high power microwave amplifier circuits to enable Navy systems to simultaneously operate over greater bandwidths, higher power and improved sensitivity. The materials and processing issues that contribute to the instability failure mechanisms of wide bandgap devices (SiC and GaN) at microwave frequencies were initially determined. Results of this work accelerated the insertion of wide bandgap technologies into DoD systems and have collateral return in the area of power switching for applications such as the all-electric ship. Developed the design of the individual channel filters to be used in high power (20W/channel) channelizers, small enough to be used behind a transmitter array face as power combiners in a multifunction system. The high power channelizer effort is essential to multiple simultaneous signal transmission and is currently unavailable except in units about 4 times the required size. Transitioned the development of a high power, wideband isolator technology needed for Naval surveillance systems from the low frequency range (1-4 GHz) to the high frequency range (4-20 GHz) by redesigning the edge mode isolator device. An alternative approach to achieve wide bandwidth using a circulator device was evaluated. Continued development of a direct digital synthesizer (DDS) frequency source to 20 GHz with programmable integral modulation capabilities for application to a new class of multifunction electronically scanned arrays with the demonstration of low phase noise performance. Continued the high performance analog-to-digital converter (ADC) effort with the development of bandpass designs to reduce the complexity, hardware parts count, and cost of receivers used in multifunction system arrays. Continued the development of compact tunable filters by designing a variable bandpass filter that can have the frequency tuned in 100 MHz steps over most of the 6 to 18 GHz band. This design, based on radio frequency (RF) Micro Electromechanical Systems (MEMS) technology, will enable a significant reduction in package size compared to other tunable filter techniques and will enable testbed demonstrations of software-selected digital reception. Continued development of the 100 GHz low noise clock

to enhance the range of frequency tuning with the demonstration of methods to produce 100 nW of output at exactly 100 GHz. Continued development of robust, wide bandgap low noise amplifiers with the integration of AlGaN HEMTs to form high gain, low noise amplifier (LNA) circuits. The use of AlGaN will provide for a more compact LNA by eliminating the need for input protection diodes. Continued development of ultra low-noise, broadband, high linearity receiver amplifiers for multifunction systems applications with the demonstration of 4-20 GHz receiver amplifiers using an optimized Metamorphic HEMT structure with increased linearity and dynamic range to further reduce intermodulation products. Developed large Silicon Carbide (SiC) BJT's with optimized design to realize Ion = 10A and VB=1200 for application to a 16-40 kW motor drive. Development of a MW frequency DDS capable of generating very stable RF/microwave frequency sources for use in wide bandwidth communications, high-resolution radar and electronically scanned arrays operating to 4.5 GHz continued with the efforts to package the DDS with an integral modulator in integrated circuit form. Demonstrated a low phase noise digitally programmable true-time delay (TTD) monolithically integrated circuit which can be used in high performance RF beamsteering. Continued development of silicon-compatible 4 Gb/in^2 giant magneto-resistance (GMR) non-volatile memory technology to implement a hard-drive on a chip by successfully fabricating a 4 Gb/in^2 basic GMR non-volatile memory cell and demonstrating a methodology to address the cell. The fabrication and testing transitioned to government contractors to increase production and testing.

FY 2003 Plans:
Continue the development of octave bandwidth linearizers with emphasis placed on circuit design using the results of the architecture study as a basis. Continue 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 SiC and GaN devices. Continue the effort to develop high power channelizers by demonstrating the feasibility of meeting channelizer size and power requirements in a single filter. Develop a preliminary design for the channelizer. Continue 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. Continue development of a DDS frequency source with programmable integral modulation capabilities with the demonstration of submicron scaling of Indium Phosphide (InP) transistors to 0.8 microns needed for complex circuits operating at clock speeds to 20GHz. Demonstrate packaging of microwave frequency DDS with integral modulator in integrated circuit form for use in an electronically scanned array operating to 4.5 GHz. Continue development of a high performance analog-to-digital (ADC) by demonstrating the desired band pass characteristic along with the hardware design, fabrication, and test of critical components. Continue development of compact tunable filters with the fabrication and demonstration of RF MEMS filter elements and modules that will demonstrate size and RF performance requirements in a 5 bit filter assembly. Demonstrate expected ultra-low phase noise performance of free running oscillator over the short time scales, critical for accurately clocking digital circuits, and develop the phase locking circuit to provide, over long time scales, the same noise performance required to accurately beam steer a 10 m^2 phased array. Develop monolithic wide bandgap low noise receiver amplifiers with increased survivability under RF drive, enhanced linearity, and high temperature operation. Within the SiC power converter effort, develop and demonstrate BJT's and PiN diodes with Ion=25A and Vb=1200 for application to a 40-100 kW motor drive.

FY 2004 Plans:
Continue the development of octave bandwidth linearizers by fabricating and testing linearizers with 2 GHz of bandwidth. The Silicon Carbide (SiC) reliability effort will emphasize full RF life tests for both discrete devices and Monolithic Microwave Integrated Circuits (MMICs). GaN efforts will continue to broaden the database for infant mortality issues in discrete devices and begin to establish approaches to RF life testing of GaN HEMTs. Within the high power channelizer effort the complete channelizer will be iterated with packaging and manufacturability issues addressed. Continue the development of high power, wideband, isolators by demonstrating increased power handling (up to 20 Watts) and reduced losses (<1 dB). The effort on DDS frequency source development to 20 GHz will emphasize enhanced performance and yield of the InP transistor devices in order to demonstrate improved DDS speed and increased spurious free dynamic range. Improve the performance of the superconducting ADC with respect to signal-to-noise (S/N) ratio and bandwidth. Pursue techniques to realize a reliable, rugged cryocooler and other special packaging required for superconducting parts. Within the 100 GHz low noise clock effort, evaluate full circuit phase noise performance for a packaged unit and analyze issues of clock signal distribution in arrays. Optimize the wide bandgap low noise receiver amplifier designs by targeting specific spectral bands. Explore approaches to the utilization of these amplifiers with reduced limiter protection.

FY 2005 Plans:
Continue the development of octave bandwidth linearizers with the fabrication and testing of 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. GaN reliability will begin to emphasize RF life testing of discrete devices and will establish approaches to RF life testing of GaN based MMICs. The first channelizer units will be available for the Advanced Multifunction Radio Frequency Concept (AMRF-C) Version 2 (V2) testbed system construction and next generation specifications will be developed. 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. Incorporate true Time Delay (TTD) into the DDS to facilitate RF microwave beamsteering in a single packaged monolithic integrated circuit. Perform testing of the superconducting ADC, demonstrate a fieldable cryocooler and plan for integrating superconducting ADC with the cryocooler. Demonstrate functionality of the 100 GHz low noise clock by integrating the clock with the high speed superconducting ADC. Develop MMIC designs for the optimal utilization of the wide bandgap LNAs with enhanced survivability.

	FY 02	FY 03	FY 04	FY 05
Naval Fleet/Force Technology Office	1,870	4,849	0	0

Ensures the Fleet/Force (F/F) helps shape the DoN investment in S&T, develop teaming relationships to rapidly demonstrate and transition technology, support development of technology-based combat capability options for naval forces, and enable warfighting innovations based on technical and conceptual possibilities. This is accomplished

through proactive connectivity and collaboration between DoN S&T and Joint, Navy, and Marine Corps commands worldwide. Efforts executed by NFFTIO are used to accelerate the process of exploring good ideas and initiatives that originate in the Fleet/Force. Special emphasis is given to force protection, development of transformational capabilities, and Command, Control, Communications, Computers, Intelligence, Surveillance, & Reconnaissance (C4ISR).

FY 2002 Accomplishments:
Special emphasis was given to efforts in force protection, development of transformational capabilities, and C4ISR. Specifically, support to develop the following systems was provided: Ship Suitability Test for Unambiguous Warning Device; Tactical Evaluation of Mine Countermeasures (MCM) Performance and Mine Jamming Against Advanced Sea Mines; and Remote Water Craft (RWC) project for force protection and counter-drug applications. Amphibian Suit and the Flight Deck Planning Tool addressed F/F operational readiness and combat capability issues that were amenable to the demonstration and application of technology solutions. Other applications were Force Protection Range Training Software and Tactical Exploitation of Side Scan Sonar Data.

FY 2003 Plans:
The efforts within NFFTIO listed above will be completed.

FY 2004 Plans: Not Applicable.

FY 2005 Plans: Not Applicable.

Congressional Plus-Ups:

	FY 02	FY 03
Advanced Semiconductor Material Research	0	1,467

Advance the performance and capability of monolithic multifunctional crystalline oxide on semiconductor films for high power amplifiers.

	FY 02	FY 03
Development of Magnetic Random Access Memory	*0	0

(*$966 appropriated in PE 0602234N)
Explored materials and developed a fabrication approach to demonstrate high density magnetic random access nonvolatile memory technology.

	FY 02	FY 03
High Brightness Electron Sources	*0	2,054

(*$1,442 appropriated in PE 0602234N)
FY 2002: Fabricated and characterized low work function materials for application to high brightness sources.
FY 2003: Field emitters will be fabricated and tested using the results of the FY 2002 efforts as a basis.

	FY 02	FY 03
Highly Mobile Tactical Communications (HTMC)	0	977

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

	FY 02	FY 03
Maritime Synthetic Range	4,141	4,988

FY 2002: Developed the synthetic virtual range at the Pacific Missile Range Facility (PMRF) to extend PMRF's capability. This tied the Maui High Performance Computer Center (MHPCC's) resources to inject realistic world models with real time systems. Combining various aspects of the UHF Electronically Scanned Array (UESA) radar testbed, Theater Under Sea Warfare (TUSW), and other sensors with the Tactical Component Network (TC) as the backbone architecture, the Navy developed a synthetic range capability centered at PMRF to extend the capability of PMRF.
FY 2003: Expand the Pacific Missile Range Facility (PMRF) capabilities integrating synthetic systems with live systems to provide a wargaming setting with multiple training range integration. These systems will be synchronized to increase the complexity of training and tests and provide a realistic setting for joint-to-unit training with coordinated operational forces.

	FY 02	FY 03
MicroArray Technology	*0	0

(*$3,366 appropriated in PE 0602234N)

Developed protein microarray and advanced DNA technology for Navy and Marine Corps needs. Applications included technology to improve force health protection; analyzed critical stages in the function of pathogenic microoganizms and developed tools for advanced forensic analysis; identified targets for the development of vaccines, antibiotics and antitoxins; and served as a diagnostic tool for military health care delivery.

	FY 02	FY 03
Nanoscale Devices	963	0

Developed nano-meter dimension electronic devices based on wide bandgap semiconductor materials which were used as sources of high power, high frequency electromagnetic radiation for applications in radar and communications systems.

	FY 02	FY 03
Nanoscale Science and Technology	1,444	1,467

FY 2002: Performed applied research to advance the understanding and application of magnetic, electronic and optical nanostructures leading to programmable logic, mass storage, non-volatile storage, and electromagnetic devices.
FY 2003: Focus on development of prototype electronic piezoelectric and optical devices made with new materials, including nanoscale magnetoresistive sensors, piezoelectric sensors, and neuromorphic networks.

	FY 02	FY 03
Silicon Carbide (SiC)Semiconductor Material Development	*0	0

(*$1,352K appropriated in PE 0602234N)
Developed techniques to provide a solid scientific framework for the growth and wafering of SiC that is useful to industry, academia, and government laboratories.

	FY 02	FY 03
Silicon Carbide High Powered Diode Development	0	1,711

Investigate 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 02	FY 03
Thick Film Ferrite Magnetic Material	*0	0

(*$970 appropriated in PE 0602234N)

Developed the growth technology to produce thick hexagonal ferrite films with large saturation magnetization for use in microwave applications.

	FY 02	FY 03
Vacuum Electronics	0	4,890

Provide an enhanced modeling code for millimeter wave countermeasures against millimeter wave sensing missiles, using vacuum tubes.

	FY 02	FY 03
Wide Bandgap Silicon Carbide Semiconductor Research Initiative	0	1,711

Bulk crystal growth and wafering of SiC for high power electronics will be developed.

C. OTHER PROGRAM FUNDING SUMMARY:

RELATED RDT&E:

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 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602435N
PROGRAM ELEMENT TITLE: Ocean Warfighting Environment Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Ocean Warfighting Environment Applied Research	60,549	71,027	48,785	63,729	58,657	58,228	54,590	55,495

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) 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 the PE are met through measuring, analyzing, modeling and simulating, and applying environmental factors affecting naval material and operations in the BSE. This PE 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.

Recently, a new strategy, referred to as the Naval Transformation Roadmap, has been formulated; the efforts in this Program Element strongly support Sea Shield. 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 PE 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, from sea to land).

The Navy program includes projects 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.

B.PROGRAM CHANGE SUMMARY:

	FY	FY	FY	FY

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602435N
PROGRAM ELEMENT TITLE: Ocean Warfighting Environment Applied Research

	2002	2003	2004	2005
FY 2003 President's Budget Submission:	62,035	55,180	55,570	55,480
Adjustments from FY 2003 President's Budget:				
NWCF Rate Adjustments			- 395	- 40
SBIR Adjustment	- 266			
Congressional Rescissions/Adjustments/Undist. Reductions	- 303	- 832		
Execution Adjustments	- 917			
Congressional Plus-ups		17,450		
Efficiencies at NWCF Activities			- 170	- 180
S & T Program Adjustments			-4,925	10,147
Pay Raise/Inflation Adjustments		- 771	-1,295	-1,678
FY 2004/2005 PRESIDENTS'S Budget Submission:	60,549	71,027	48,785	63,729

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 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 2002 ACTUAL	FY2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Ocean Warfighting Environment Applied Research	60,549	71,027	48,785	63,729	58,657	58,228	54,590	55,495

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project 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). Natural-environment and BSE are used interchangeably; each term is to be understood to potentially encompass aspects of the ocean, atmosphere, space, or land.

This project also 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 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) enacted into law for FY 1997. A major component of the program supports general needs in the area of Mine Countermeasures (MCM). The objectives of the PE are met through measuring, analyzing, modeling and simulating, and applying environmental factors affecting naval material and operations in the BSE.

This project provides for BSE technology developments that contribute to meeting top joint warfare capabilities established by the Joint Chiefs of Staff. Major efforts of this PE are devoted to (1) gaining real-time knowledge of the BSE, (2) determining the natural-environment needs of regional warfare, (3) providing the on-scene commander 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 Oceanographic Command 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. Programs 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. Programs include influences of the natural environment on air operations, electromagnetic (EM)/electro-optic (EO) systems used in intelligence, surveillance and reconnaissance and targeting, bomb damage assessment, and detection of missile weapon systems. They also include improvements in tactical information management about the BSE.

Recently, a new strategy, referred to as the Naval Transformation Roadmap, has been formulated; the efforts in this project strongly support Sea Shield. 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 project 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, from sea to land).

The Navy program includes projects that focus on, or have attributes that enhance, the affordability of warfighting systems.

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

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Battlespace Environment (BSE) Sensors and Data	7,209	8,133	7,295	10,880

This activity encompasses efforts to develop new, or enhance existing, shipboard, in-situ, 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 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 2002 ACCOMPLISHMENTS:

- Additional focus was given to: Global 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), and autonomous underwater vehicle sensors and technology for oceanography and mine countermeasures (MCM).

- Completed the advanced ocean wave prediction model development which improves the predictive capability of wave prediction in the littoral region and established a mechanism by which other developments in wave prediction can easily transition to the fleet.

FY 2003 PLANS:

- Continue developments in: GODAE, bioluminescence sensor, field data for physics-based models for hyperspectral imaging sensors, naval impact of natural environmental processes (especially for the littoral zone), and autonomous underwater vehicle sensors and technology for oceanography, mine countermeasures, and prediction of mine burial.

- NATO Adriatic circulation experiment will field test a new bottom sensor system and use data for rapid environmental assessment.

FY 2004 PLANS:

- Continue support of efforts in GODAE as a contribution to data assimilation for global ocean prediction capability through collaboration between the Navy's Fleet Numerical Meteorological and Oceanographic Command and the NOAA Pacific Marine Environmental Laboratory, as well as others.

- Continue with efforts to transition the small, low-power, lightweight bioluminescence sensors, which are of special importance to Special Forces and their operations.

- Use space-based optical sensors as input for system performance of both active and passive optical MCM sensors.

- Perform analysis of extensive field data for physics-based models for hyperspectral imaging sensors of the ocean surface/near-surface to establish what information can be deduced from such sensors about the upper layers of the ocean. This effort promises to put a firm foundation to this significant new technology.

- Naval impact of natural environmental processes, such as fluid/sediment processes, in the littoral zone continues to be a key area of development, with applications to mine burial and littoral warfare in general.

- Develop a shipborne Light Detection and Ranging (LIDAR) system for measurement of winds and the near-surface EM/EO propagation environment.

- Autonomous Underwater Vehicle (AUV) technology continues to represent a major area of technological revolution for ocean sensing. Continue efforts to develop ocean sensors for use on AUVs and the development of acoustic communication capabilities to transfer data so acquired to facilities in the field. Extend capability to predict acoustic communication channel error rate performance for networked systems.

- Continue efforts to utilize organic sensors for Rapid Environmental Assessment (REA).

- Continue with further advancements in 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. Ocean waves constitute a key process in the littoral zone with the ability to affect many naval operations and we seek as robust a predictive capability as possible.

FY 2005 PLANS:

- Continue support of efforts in GODAE as a contribution to data assimilation for global ocean prediction capability through collaboration between the Navy's Fleet Numerical Meteorological and Oceanographic Command and the NOAA Pacific Marine Environmental Laboratory, as well as others.

- Continue the 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. Evaluate and pursue additional opportunities for further development of the capability to utilize bioluminescence sensing capabilities for naval warfare.

- Completion of analysis of hyperspectral field data for physics-based models hyperspectral imaging sensors of the upper ocean structure. Hyperspectral imaging technology offers new possibilities in inferring critical ocean structural aspects such as near-surface layers and ocean fronts, both of which can influence acoustic and light transmission in the ocean. Give full consideration to the possibilities of utilization of hyperspectral data for naval warfare. Transition results to fleet operational capabilities.

- Naval impact of natural environmental processes, such as fluid/sediment processes, in the littoral zone continues to be a key area of development, with applications to mine burial and littoral warfare in general.

- Conduct a field test of a shipborne LIDAR system for near-surface environmental characterization.

- Continue with efforts to develop ocean sensors for use on AUVs and the development of acoustic communication capabilities to transfer data so acquired to facilities in the field. Utilize joint field work with other AUV technology developers and users as a routine aspect of the program.

- Continue with further advancements in ocean wave prediction, especially shoaling waves, based on the extensive basic research measurement programs in this area over the past decade. Ocean waves constitute a key process in the littoral zone with the ability to affect many naval operations and we seek as robust a predictive capability as possible.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602435N Project Title: Ocean Warfighting Environment Applied Research
PROGRAM ELEMENT TITLE: Ocean Warfighting Environment Applied Research

	FY 02	FY 03	FY 04	FY 05
Battlespace Environment (BSE) Concept Enablers	19,827	22,091	20,647	24,322

Concept enablers for the battlespace environment represent technology developments that are expected to provide revolutionary, enabling capabilities but require a long period of development. Generally, the concept enablers represent ideas of wide applicability for which the basic research has been accomplished with indications as to a high payoff to naval warfare interests. Consideration is routinely given to the goals 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. Continual evaluation is given to concept enabling technologies that emerge from basic or applied research and may lead to modifications of on-going efforts. 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 in which innovative developments are sought “to achieve transformational operational concepts and capabilities.”

FY 2002 ACCOMPLISHMENTS:

- Efforts were aimed at providing naval battlespace awareness, precise time/time interval for precision location, geoclutter, the National Oceanographic Partnership Program (NOPP), SecNav/CNO Ocean Chairs, and collaborative efforts with basic research programs.

- Continued the National Oceanographic Partnership Program (NOPP) program which represents collaboration between 14 Federal agencies to provide leadership and coordination of national oceanographic research and education; NOPP facilitates new interactions among federal agencies, academia, and industry that lead to partnership activities in oceanographic research aimed at major advances in ocean observation and prediction. NOPP continues to be focused on the national needs of an integrated ocean observing system.

- NOPP solicited proposals for a FY2002 Broad Agency Announcement(BAA) for Ocean Biogeographical Information System (OBIS) (this is the outcome of an earlier decision by the Science Ministers of 29 countries to establish a Global Biodiversity Information Facility; NOPP and the Sloan Foundation seek through the BAA to capitalize on an initial effort begun in FY 2000 in this topic).

- Initiated the following NOPP efforts: Real-Time Forecasting System of Winds, Waves, and Surge in Tropical Cyclones; The Partnership for Advancing Interdisciplinary Global Modeling (PARADIGM); and a Partnership for Modeling the Marine Environment of Puget Sound, Washington.

- Further development occurred in air-sea interaction because of the importance of this area to improve both ocean and atmospheric forecasts.

- Efforts further advanced a methodology for capturing uncertainty in environmental predictions as a means of giving the "user" an idea of the reliability of those predictions.

- Completed the biosensor technology effort.

- The question of the impact of noise, as generated by naval activities, on marine mammals has become of increasing concern. Initiated an effort to participate in a jointly conducted marine mammal program to focus on the effect of noise on marine mammals and to provide tools to detect and mitigate effects.

FY 2003 PLANS:

- Continued efforts for determining precise locations through precise time/time interval technology. This is a capability of great importance in littoral regions where numerous obstacles to passage, such as underwater mines, may occur and knowledge of their precise location.

- Additional development is given to geoclutter, as a means of developing better insights into how the sub-sediment seafloor may contribute to acoustic clutter.

- Further develop methods for capturing uncertainty with the ultimate goal of providing the user of environmental predictions some idea as to the reliability of the predictions.

- Air-sea interaction measurements and theory receive additional analysis and development. Efforts here are expected to have an impact on better ocean models and better 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.

- Continue support of "Ocean.US" Office (which is a component of NOPP) that represents the US component of a global ocean observing system with several aims (detecting and forecasting oceanic components of climate variability, facilitate safe and efficient marine operations, ensure national security, managing

resources for sustained use, preserving and restoring healthy marine ecosystems, mitigating national hazards, and ensuring public health). Consideration will be given to the solicitation of additional NOPP projects to further advance toward an integrated ocean observing and prediction system.

- Continue the SecNav/CNO Ocean Chairs program.
- Develop new possibilities in biosensor technology.
- Continue collaborative efforts with the basic research program.

FY 2004 PLANS:

- Continue development of precise time/time interval technology (which is at the base of Global Positioning System (GPS) technology) for improvements in determining location.
- Continue developments, through theory and field measurement, in the air-sea interaction effort as a means of improving both ocean and atmospheric forecasts. The results will also contribute towards a better understanding of how aerosols are ejected from the ocean into the atmosphere where they modify propagation characteristics of electromagnetic/electro-optic signals and, thereby, influence radar and infra-red devices used in naval warfare systems.
- Complete an effort in capturing uncertainty in environmental predictions as a means of giving the user an idea of the reliability of those predictions. There is a crucial need for this capability, especially in the littoral zone where so much variability in the environment may occur. This effort also establishes directions for additional developments in this challenging new area of technology.
- Complete the 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.
- Continue the marine mammal program on noise mitigation as a means of developing tools to detect and mitigate effects of noise on marine mammals, especially the noise generated by naval activities; such tools will enable planners and environmental compliance document preparers to synthesize quantitative 4-D information about sound fields and animal movements.

- Continue the following NOPP efforts begun in earlier years: Real-Time Forecasting System of Winds, Waves, and Surge in Tropical Cyclones; PARADIGM: The Partnership for Advancing Interdisciplinary Global Modeling; A Partnership for Modeling the Marine Environment of Puget Sound, Washington; Multi-Disciplinary Ocean Sensors for Environmental Analyses and Networks.

- 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).

- Other NOPP initiatives include: Solicit efforts from the national oceanographic community that will advance the NOPP program towards its goal of an integrated ocean observing and prediction system; utilize maximum participation of the national oceanographic community in forming partnership projects with cost sharing; continue the joint program with the Sloan Foundation toward establishment of an ocean biodiversity program.

- Continue the SecNav/CNO Ocean Chairs Program, which represents one way in which leading ocean researchers are focused on topics of current importance to naval warfare.

- Continue development of new possibilities in biosensor technology.

- Continue collaborative efforts with basic research that have a high potential for leading to advances in gaining tactical mastery over the environment.

FY 2005 PLANS:

- Continue development of precise time/time interval technology (which is at the base of Global Positioning System (GPS) technology) for improvements in determining location.

- Complete the air-sea interaction joint work with the basic research program. This effort yields a better understanding of the interaction process in the very low wind-speed and high wind-speed regimes where past measurements have been sparse. Results established here represent an important means by which air-sea interaction in these regimes can be more accurately incorporated in ocean and atmospheric predictive models. Results here are also important for developing better predictive capabilities for describing how aerosols are injected into the lower atmosphere where they have a direct impact on electromagnetic/electro-optic sensors for surveillance purposes and, in particular, for detection of sea-skimming missiles.

- Validate Hilbert-Huang transform analysis for non-linear/non-stationary wave propagation in the littoral region to improve the ability at space-based assessment of littoral surface waves, currents, and bathymetry.

- Continue the marine mammal program on noise mitigation as a means of developing 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; PARADIGM: The Partnership for Advancing Interdisciplinary Global Modeling; A Partnership for Modeling the Marine Environment of Puget Sound, Washington; Multi-Disciplinary Ocean Sensors for Environmental Analyses and Networks.

- Complete the following NOPP efforts: A Consortium for Data Assimilative Ocean Modeling; A Consortium for Ocean Circulation and Climate Estimation.

- Solicit efforts from the national oceanographic community that will advance the NOPP program towards its goal of an integrated ocean observing and prediction system. Complete the joint program efforts initiated in FY02 with the Sloan Foundation focused on establishing an ocean biodiversity program.

- Continue the SecNav/CNO Ocean Chairs Program which represents one innovative means by which leading ocean researchers are focused on topics of current and future importance to naval warfare.

- Continue development of new possibilities in biosensor technology.

- Continue collaborative efforts with basic research that have a high potential for leading to advances in gaining tactical mastery over the environment.

	FY 02	FY 03	FY 04	FY 05
Ocean and Atmospheric Modeling/Prediction and Effects	11,662	12,963	11,463	15,252

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 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 in this applied research program. Critical new developments in computer technology, such as faster and more capable main frame computers, must be monitored for their potentially significant implications in terms of this activity. Capabilities in this area have rapidly matured over the past several years and similar maturation is expected to continue in future developments, all to the benefit of modeling/prediction needs for naval warfare. Therefore, the expectation is to achieve better decision-making capabilities relative to "go" or "no-go" decisions for contemplated actions; also expected is an improved means by which naval forces can gain mastery over the environment and deny an adversary "home field" advantage. 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 2002 ACCOMPLISHMENTS:

- Efforts continued in ocean model nowcast/forecast at a variety of scales (global, regional, semi-enclosed seas, local), including relocateable and nested models. A variety of scales are necessary because of the differing types of application in which differing resolutions arise. Nested models are needed to allow for a larger domain ocean model to set boundary conditions for a smaller domain model.

- Continued developments in advanced on-board ocean models to maximize the on-board forecast capabilities available to the on-scene commander.

- Continued model testing/validation, often with the joint participation of the Fleet Numerical Meteorological and Oceanographic Command (where models are ultimately used by the Fleet for operational predictions).

- Continued development on coupled ocean/atmosphere models to allow for more accurate ocean and atmospheric models.

- Continued efforts in nested atmospheric models (global, regional, local) and on-scene weather prediction toward more efficient schemes for operational evaluation and use.

- Continued development of atmospheric effects on electromagnetics/electro-optics because of the central importance of electromagnetic and electro-optic propagation to so many modern warfare systems. Construction of an end-to-end observation/analysis/prediction system for coastal aerosol and dust has become and remains a recent focus of activities in atmospheric effects.

FY 2003 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 development in advanced on-board ocean models to maximize the on-board forecast capabilities available to the on-scene commander.
- Continue model testing/validation. Transition the Navy Coastal Ocean Model (NCOM) for operational test/evaluation at the Naval Oceanographic Office (NAVO). Initiate an effort to incorporate an upgraded Polar Ice Prediction System (PIPS3) into NCOM to extend its applicability.
- Continue development on coupled ocean/atmosphere models to allow for more accurate ocean and atmospheric models.
- Continue efforts in nested atmospheric models (global, regional, local) and on-scene weather prediction toward more efficient schemes for operational evaluation and use.
- Continue research on the atmospheric effects on electromagnetics and electro-optics. This is important because of the central importance of electromagnetic and electro-optic propagation to so many modern warfare systems. Construction of an end-to-end observation/analysis/prediction system for coastal aerosol and dust continues to be an important focus of activities in atmospheric effects, primarily due to the significance of these components of the atmosphere (as demonstrated in the Persian Gulf conflict and, most recently, in Operation Enduring Freedom). Efforts also aim to build on recent successes of the application of atmospheric modeling demonstrated in Operation Enduring Freedom.

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.
- Employ ocean models to complete three dimensional 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 Navy Coastal Ocean Model.

- Complete and transition to NAVO data quality control and data assimilation techniques to upgrade the operational "Shallow Water Analysis and Forecast System" for ocean nowcast/forecast capability.

- Continue development in advanced on-board ocean models to maximize the on-board forecast capabilities available to the on-scene commander.

- Complete and transition to NAVO and Navy SEAL forces the laptop-based nearshore forecast system that makes use of Autonomous Underwater Vehicle (AUV) collected data. This will represent a state-of-the-art nearshore environmental forecast capability relevant to naval operations that maximizes use of on-scene data in an environment that can change quickly.

- Continue model testing/validation. Work towards completion of the first generation of coupled ocean/atmosphere models and pursue additional development to allow for more accurate ocean and atmospheric predictions of global and regional scales.

- Continue development of nested atmospheric models (global, regional, local) and on-scene weather prediction to predict atmospheric parameters critical to naval platform, sensor, and weapon performance. Real-time, high-resolution techniques to enhance environmental support for operations, mission planning, and system development, especially in the littoral zone, are focal aspects of the program. Implement improvements to existing numerical weather prediction skill by extending models to 100km for evaluation purposes.

- 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.

- Continue construction of an end-to-end observation/analysis/prediction system for coastal aerosol and dust.

FY 2005 PLANS:

- Continue advancing efforts in ocean model nowcast/forecast at a variety of scales (global, regional, semi-enclosed seas, local), including relocateable and nested models.

- Continue developments in nested models 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 model testing/validation. Evaluate improvements of weather forecasting skill from assimilation of stratospheric data and extension of models to 100km.

- Continue development of coupled ocean/atmosphere models to the next stage based on performance and results of research. Exploit opportunities for joint field testing and experiments with other groups, especially where acoustic or biological or optical properties of the medium allow a common interest.

- Continue development of nested atmospheric models (global, regional, local) and on-scene weather prediction to predict atmospheric parameters critical to naval platform, sensor, and weapon performance. In general, higher resolution, faster time steps, on-scene capability, and custom applications are areas of desired model improvement.

- Complete major atmospheric field experiment in the North Pacific and North Atlantic with the National Science Foundation, the National Oceanographic and Atmospheric Administration, and international participants to accelerate improvements in short-range (up to 3 days) and medium-range (3 to 10 day) deterministic and probabilistic (ensemble) predictions and warnings of high-impact weather over the Northern Hemisphere. Real-time, high-resolution techniques to enhance environmental support for operations, mission planning, and system development, especially in the littoral zone, are focal aspects of the program.

- Complete the first generation of coupled ocean/atmosphere models and pursue additional development to allow for more accurate ocean and atmospheric predictions of global and regional scales.

- 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. Continue construction of an end-to-end observation/analysis/prediction system for coastal aerosol and dust.

- Complete first tests of coupled global and regional aerosol prediction system. Efforts also aim to build on recent successes of the application of atmospheric modeling demonstrated in Operation Enduring Freedom.

	FY 02	FY 03	FY 04	FY 05

Naval Warfare System-Focused Efforts	10,372	10,776	9,380	13,275

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. Where feasible, joint field work is conducted with system developers to maximize the opportunity to focus on the question of impact of the environment on the system and performance prediction. The littoral zone has been the natural environment of greatest interest; aspects of this environment that greatly impact naval warfare are the generally shallow waters of the littoral zone, 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 2002 ACCOMPLISHMENTS:

- Continued efforts in 3-D geoacoustic predictions and inversion of chirp sonar data for seabed inhomogeneities through comparisons of geoacoustic inversion data with core measurements, mathematical transform methods, and high frequency bottom techniques.

- Pursued further advances in remote sensing techniques, especially hyperspectral imaging technology, for the littoral zone because of their very promising potential to allow inference of littoral ocean characteristics and overcome the problem of "denied" waters.

- Continue developments on several aspects of underwater acoustics because of their general importance to acoustic systems:
  -Acquired acoustic data to determine the time-dependent acoustic array performance degradation for environmental impact on acoustics.

  -Performed joint field experiments with SACLANTCENTRE aimed at better characterization of soliton internal wave packets.

  -Completed and utilized environmental reconstruction of large experimental areas (hundreds of meters horizontally) for determination of internal wave/coastal front influences on acoustic propagation.

FY 2003 PLANS:

- Develop extensions to 3-D geoacoustic prediction for "stochastic" inversions seeking improvements in speed and accuracy of inversion algorithms.

- Continue development in remote sensing techniques, especially hyperspectral imaging technology, for the littoral zone because of their very promising potential to allow inference of littoral ocean characteristics and overcome the problem of "denied" waters.

- Continue development of several aspects of underwater acoustics because of their general importance to acoustic systems:
  -Validate models of horizontal acoustic coherence through oceanographic reconstructions for environmental impact on acoustics.

  -Modify the primitive equation soliton model for the Yellow Sea and transition the capability for soliton internal wave packet predictions,

  -Determine acoustic focusing and the predictability of acoustic energy fluctuations due to the internal wave/coastal front influences on acoustic propagation.

- Initiate measurements and modeling of ship wake acoustics for anti-torpedo torpedo acoustic performance prediction.

- Incorporate improved shock physics and numerics into an explosive mine neutralization model.

FY 2004 PLANS:

- Continue with developments in the area of utilization of acoustic processing techniques to perform acoustic inversion or geoacoustic inversion for environmental parameters, techniques for discrimination between environmental scatterers and target, and through-the-sensor measurements and adaptation of sensors to the environment. Such developments will allow sonar systems to measure their operating environment directly and adapt their operational settings and signal processing to that local knowledge.

- Continue development in remote sensing techniques, which include passive/active optical, electromagnetic, and acoustic techniques. Hyperspectral imaging technology is of special interest because of its great promise. All of these techniques are significant for the littoral zone because of their potential to allow inference of littoral ocean characteristics and overcome the problem of "denied" waters, especially in terms of beach and coastal ocean classification methodology. Initiate development of electro-optical approaches to surf zone characterization.

- Pursue techniques to allow determination of sediment microfabric and geotechnical properties and their exploitation in naval warfare, especially related to mine burial and prediction.

- Continue with developments in the area of underwater acoustics and the impact of ocean dynamics on underwater acoustics because of their general importance to acoustic systems, which are so heavily relied on in antisubmarine warfare and mine warfare. Quantify and relate variability of acoustic array gain to ocean fine scale processes. Important objectives are the integration of environmental knowledge into acoustic signal processing, underwater noise prediction and characterization, and noise models. Develop additional ability 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 with 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 measurements and modeling of ship wake acoustics for anti-torpedo torpedo acoustic performance.

- Continue improvements in shock physics and numerics for an explosive mine neutralization model.

FY 2005 PLANS:

- Continue with developments in the area of utilization of acoustic processing techniques to perform acoustic inversion or geoacoustic inversion for environmental parameters, 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, especially the hyperspectral techniques which offer new possibilities for exploitation based on previous investigation of the physics-basis in the littoral zone.

- Continue development of techniques to allow determination of sediment geoacoustic and geotechnical properties and their exploitation in naval warfare.

- Continue with developments in the area of underwater acoustics and the impact of ocean dynamics on underwater acoustics. 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 with 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.

- 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 MCM weapon systems using improved sediment shock physics models.

Congressional Plus-Ups:

	FY 02	FY 03
Bioluminescence Truth Data and Signature Detection	963	977

Bioluminescence Truth Data and Signature Detection: 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. Affordable, compact, efficient sensors that allow ease of deployment and permit the rapid measurement of bioluminescence in the ocean now seem feasible.

FY2002 ACCOMPLISHMENTS:

- The work supported by this plus-up conducted developments in affordable, compact sensors: instruments for use on general survey ships or underwater vehicles for background bioluminescence data, instruments for use on autonomous platforms for application in mine warfare and anti-submarine warfare, instruments for use in Navy special warfare operations.

FY2003 PLANS:

- Continue development efforts, based on previous advances, aimed toward affordable, compact sensors: instruments for use on general survey ships or underwater vehicles for background bioluminescence data, instruments for use on autonomous platforms for application in mine warfare and anti-submarine warfare, instruments for use in Navy special warfare operations.

	FY 02	FY 03
Littoral Acoustic Demonstration Center	963	N/A

The Littoral Acoustic Demonstration Center provides developments in the general areas of underwater acoustic noise and its effects on marine mammals as well as characteristics of shallow water acoustic propagation; these topics are of critical importance in assessing the impact of naval operations on marine life.

FY 2002 ACCOMPLISHMENTS:

- Performed development in the area of better strategies for monitoring underwater acoustic ambient noise with specific application to marine mammal identification and movement or tracking, unpredictability of shallow water acoustic propagation, statistical characterization of shallow water ambient noise, acoustic monitoring and mitigation techniques for marine mammals, and ocean measurement/experimentation.

	FY 02	FY 03
Multiple Intelligent Distributed Underwater Vehicles and Sensors	2,889	N/A

Multiple Intelligent Distributed Underwater Vehicles and Sensors: Underwater vehicle technology and sensor development have recently demonstrated many successes in applications to oceanography and mine countermeasures. Past development has basically focused on single-vehicle development and application. This plus-up focused on the development of technology appropriate to the use of multiple intelligent distributed underwater vehicles and related sensor developments. Such vehicles must be endowed with the capability of making intelligent decisions about their operations, capable of communication with each other, and able to function in a network configuration for application to a variety of oceanographic applications.

FY 2002 ACCOMPLISHMENTS:

- Tasks of interest span a broad spectrum of measurements to define the oceanographic state, including nature of the bottom topography and of the bioluminescence/chemical aspects of the ocean. Applications of interest are: measuring ocean conditions for input to ocean models for near real-time ocean nowcast/forecast; use of multiple intelligent vehicles in mine countermeasure operations; use of multiple intelligent vehicles in covert ocean survey operations to gain information about the ocean battlespace and deny an adversary "home-field" advantage.

	FY 02	FY 03
Oceanographic Sensors for MCM	4,912	4,988

Technology advances over the past several years have formed a basis for development of ocean sensors that can be adapted for use on autonomous vehicles, thereby giving the Navy a new capability in mine countermeasure operations and/or in sampling the littoral ocean for characteristics that may affect contemplated operations.

FY2002 ACCOMPLISHMENTS:

- Developed further capabilities in oceanographic sensor technology, and related platform technology (such as autonomous underwater vehicle technology) for application especially in littoral regions to mine countermeasures. The primary aim was to demonstrate capabilities through joint field work with other programs. Further developments in this area provided a basis to additional transitions to higher category programs as well as to the recently initiated FNC in Autonomous Operations.

FY2003 PLANS:

- Continue developments to demonstrate capabilities through joint field work with other programs. This area continues to offer the potential for revolutionary capabilities in terms of mine countermeasure operations.

	FY 02	FY 03
South Florida Ocean Measurement Center	1,694	977

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

FY2002 ACCOMPLISHMENTS:

- Utilized the capabilities offered by the components of the South Florida Ocean Measurement Center to join with applied naval development efforts to further advance underwater vehicle technology and its application to naval warfare problems.

FY2003 PLANS:

- Continue to exploit the capabilities of the South Florida Ocean Measurement Center to further advance underwater vehicle technology and its application to naval warfare problems th5rough collaborative work with other applied efforts, where feasible.

	FY 02	FY 03
Hydrography Research	0	1,711

Providing high-resolution hydrographic data in near-coastal regions to the warfighter is a significant force multiplier. Because the littoral region is the probable battlefield of future conflicts, there has been an increased volume in acquisition of high-resolution hydrographic data in coastal areas. This increased volume has overwhelmed the computer capacity at the Naval Oceanographic Office (NAVOCEANO) and led to delays in processing hydrographic data in strategically/tactically significant regions.

FY2003 PLANS:

- Expand development of improvements in hydrographic data collection and data processing techniques that can be applied at NAVOCEANO with a view of allowing more rapid data processing.

	FY 02	FY 03
Extended Capability Underwater Imaging	0	1,956

Underwater optical imaging science and technology have suggested exciting new potential capabilities for naval operations underwater, especially in terms of smaller, more energy efficient design and novel image processing techniques.

FY2003 PLANS:

- Extend current underwater imaging capabilities through incorporation of versatile scanning modes, such as multi-wavelength light source and receiver combinations and multi-mode detection approaches (such as fluorescence and polarization) with a view to giving the Navy powerful new methods and sensors for underwater imaging, especially in terms of enhanced fine scale resolution and identification of underwater man-made features.

	FY 02	FY 03
Southeast Atlantic Coastal Ocean Observing System (SEACOOS)	*	5,478

*$3,843 (Appropriated in PE 0601153N in FY 02)
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.

FY2003 PLANS:

- Develop those technologies that contribute to the goals of SEACOOS, namely: linking several subregional observing systems and supplementing and enhancing the de facto operational coastal ocean observing system; establishing testbeds and observatories for fostering technology development and introducing new technology through quantitative assessments; providing a testbed for conducting observing system experiments and assessing various data assimilative coastal ocean models and information products; developing and demonstrating new data and information products via a web-based information management system, and in association with a range of user communities; creating and operating a regional information

system that will foster understanding of coastal ocean processes and coastal ecosystems on a regional scale.

	FY 02	FY 03
Southern Coastal Ocean Observation Program (SCOOP)	0	977

Oceanographic knowledge, data, tools and other products emerging from an appropriate infrastructure would support numerous future Naval operations and enable Navy to increase its participation in the on-going National Oceanographic Partnership Program (NOPP).

FY2003 PLANS:

- Utilize the Southern Universities Research Association, a consortium of 59 universities, to contribute to development of an integrated, sustained ocean observation system. SCOOP plans to integrate and extend comparable observations from the Gulf of Mexico, the Southern Atlantic Bight (from Miami to Cape Hatteras), the Middle Atlantic Bight (from Cape Hatteras to Delaware), and the Chesapeake Bay. The network will provide comprehensive coverage of the southeast and will serve as a key component of a larger national system, such as being pursued in NOPP. This effort complements the Southeast Atlantic Coastal Ocean Observing System.

C. OTHER PROGRAM FUNDING SUMMARY: The Navy's basic research program contributes strongly to this effort.

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:

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602435N Project Title: Ocean Warfighting Environment Applied Research
PROGRAM ELEMENT TITLE: Ocean Warfighting Environment Applied Research

PE 0602601F (Space Technology)
PE 0602784A (Military Engineering Technology)
PE 0603410F (Space Systems Environmental Interactions Technology)

D. ACQUISITION STRATEGY: Not Applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2

PROGRAM ELEMENT: 0602633N
PROGRAM ELEMENT TITLE: Undersea Warfare Weaponry Technology

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE
	Undersea Warfare Weaponry Technology	
SAUVIM	1,635	0
Total	1,635	0

This PE was restructured in FY 2002.

Congressional Plus-ups appropriated in this PE are described under the following restructured program elements:

TITLE	PE NUMBER	FY 2002	FY 2003
SAUVIM	0602747N	$1,635	$ 0

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602747N
PROGRAM ELEMENT TITLE: Undersea Warfare Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Undersea Warfare Applied Research	72,511	84,496	62,583	66,353	63,554	64,170	65,364	66,619

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 Element (PE). Technologies being developed within this Project Element 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.

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

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	75,834	71,294	72,850	73,324
Adjustments from FY 2003 President's Budget:				
Congressional Plus-Ups		15,150		
SBIR Reduction	-917			
Execution Adjustments	-2,152			
Congressional Rescissions/Adjustments/Undistributed Reductions	-254	-1,031		
S&T Program Adjustments			-7,835	-4,581
NWCF Rate Adjustments			-93	73
Efficiencies at NWCF Activities			-710	-701
Pay Raise/Inflation Adjustments		-917	-1,629	-1,762

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602747N
PROGRAM ELEMENT TITLE: Undersea Warfare Applied Research

FY 2004/2005 President's Budget Submission:	72,511	84,496	62,583	66,353

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

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602747N Project Title: Undersea
PROGRAM ELEMENT TITLE: Undersea Warfare Applied Research Warfare Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Undersea Warfare Applied Research	72,511	84,496	62,583	66,353	63,554	64,170	65,364	66,619

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 program 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:

	FY02	FY03	FY04	FY05
Wide Area Anti-Submarine (ASW) Surveillance	13,323	18,016	17,663	18,072

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 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 program area 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 2002 ACCOMPLISHMENTS:

- **Non-Acoustic ASW/Data Fusion Technology**

  Initiated:

  - Project to miniaturize Deployable Autonomous Distributed System (DADS) sensor and control nodes by a factor of 10 with equal or better performance for littoral ASW applications.

  Continued:

  - Development of ultra-low power electronics to support ASW advanced maritime remote sensing devices.

- **Active Undersea Signal Processing**

Initiated:
- Performance evaluation of a multistatic sonar system using air-deployed explosive sound sources and sonobuoys based on an operational concept called "non-traditional scattering".

Continued:
- Development of signal processing algorithms that reduce the number of clutter-generated false alerts, thereby improving the ability to detect weak submarine echoes.
- Development of signal processing techniques for detection, classification, and localization of threat submarines using coherent sources in a multistatic sonar system.
- Development of improved signal processing techniques for use with multistatic sonar systems that employ explosive sound sources.

- **Passive Undersea Signal Processing**

Completed:
- Development of acoustic signal processing detection, classification, and localization techniques for autonomous undersea applications.
- Assessment and report on partial aperture Hydra acoustic ASW performance during Seaweb technical feasibility demonstrations in September 2001. Seaweb refers to collection of Telesonar modems.

- **Air and Deployable ASW Sensors/Systems**

Continued:
- An assessment exploring the feasibility of using acoustic intensity sensors as active receivers for ASW applications.
- Development of an enhanced acoustic sparker source for environmental sensing and air-deployed ASW sensor applications.
- Development of system components that enable ultra-lightweight, ultra-low power air-, surface ship- or submarine-deployable, Matched Field Tracking Arrays to be used for barrier or area surveillance.
- Development of the technology to enable Telesonar acoustic communications for deployable systems.

Completed:
- In-air technical feasibility demonstrations of an X-Glider Unmanned Autonomous Vehicle (UAV) to remotely deploy multiple ASW sensors to predetermined locations.
- Assessment and final report of the technical feasibility of a partial-aperture Matched Field Tracking Array following in-water testing.

- **Multistatic ASW (Component of LASW Future Naval Capability (FNC))**

Initiated:
- Development of small, cheaper low frequency active sonar transducers for use in Navy multistatic sonar systems.
- Development and at-sea testing of Compact Deployable Multistatic Receiver (CDMR) hardware and software.
- Analysis of FY 02 multi-static source sea-test data.

Continued:

- At-sea testing of a low-frequency, submarine deployed autonomous source.
- Development and testing of signal processing software for the Compact Deployable Multistatic Receiver. Each software "build" incrementally increases the amount of processing performed in the sonobuoy and decreases the amount of data that needs to be transmitted to the command center.
- Development of threat target scattering databases using scale model submarines to enable the continuing development of forward scattering echo detection algorithms.
- Extension of Hidden Markov Model techniques to identify/classify submarine-like targets and additional environmental factors that produce scattering. Incorporated acoustic waveguide effects into the Hidden Markov Model algorithms.

Completed:
- Initial demonstration of a multistatic sonar signal processing system for submarines using a towed array to receive signals and a moored low frequency acoustic source to transmit signals.
- Development of large-aperture planar arrays and technologies for packaging them in deployable systems.
- Development of low-frequency, submarine, off-board, multi-static source hardware, signal processing algorithms, and performance prediction tools.
- Assembly of a laboratory test bed to test end-to-end performance of Compact Deployable Multistatic Receiver signal processing software.

FY 2003 PLANS:

- **Non-Acoustic ASW/Data Fusion Technology**

  Continue:
  - Development of ultra-low power electronics to support ASW advanced maritime remote sensing devices.
  - Project to miniaturize DADS sensor and control nodes by a factor of 10 with equal or better performance for littoral ASW applications.
- **Active Undersea Signal Processing**

  Continue:
  - Performance evaluation of a multistatic sonar system using air-deployed explosive sound sources and sonobuoys based on an operational concept called "non-traditional scattering".
  - Development of signal processing algorithms that reduce the number of clutter-generated false alerts, thereby improving the ability to detect weak submarine echoes.
  - Development of signal processing techniques for detection, classification and localization of threat submarines using coherent sources in a multistatic sonar system.
  - Development of improved signal processing techniques for use with multistatic sonar systems that employ explosive sound sources.
- **Air and Deployable ASW Sensors/Systems**

  Initiate:

- Development of computational intelligence algorithms aimed at efficiently and effectively activating a multistatic field of air-deployed sources and receivers.
- Development of volumetric arrays for deployables capable of tactically significant gains.

Continue:
- An assessment exploring the feasibility of using acoustic intensity sensors as active receivers for ASW applications.
- Development of the technology to enable Telesonar acoustic communications for deployable systems.

Complete:
- Development of system components that enable ultra-lightweight, ultra-low power air-, surface ship- or submarine-deployable, Matched Field Tracking Arrays to be used for barrier or area surveillance.
- Development of an enhanced acoustic sparker source for environmental sensing and air-deployed ASW sensor applications.

- **Multistatic ASW (Component of LASW FNC)**

Initiate:
- Development of "field-level" processing that combines data provided by many Compact Deployable Multistatic Receivers distributed across a large ocean region, and produces tracks of submarines moving through the region.
- Transducer, power source and power amplifier development for the new aircraft-deployable Compact Deployable Multistatic Acoustic Sound Source.

Continue:
- Development and at-sea testing of Compact Deployable Multistatic Receiver hardware and software.
- Development and testing of signal processing software for the Compact Deployable Multistatic Receiver. Each software "build" incrementally increases the amount of processing performed in the sonobuoy and decreases the amount of data that needs to be transmitted to the command center.
- Development of small, cheaper low-frequency active source transducers for use in Navy multistatic sonar systems.
- Development and at-sea testing of Compact Deployable Multistatic Receiver hardware and software.
- Extension of Hidden Markov Model techniques to identify/classify submarine-like targets and additional environmental factors that produce scattering. Incorporated acoustic waveguide effects into the Hidden Markov Model algorithms.

Complete:
- At-sea testing of a low frequency, submarine-deployed autonomous acoustic source.
- Analysis of FY 02 multi-static source sea-test data.
- Integration of Hidden Markov Model techniques with traditional submarine tracking algorithms and evaluate overall effectiveness for in shallow water ASW applications.
- Transition to Naval Air Systems Command (NAVAIR) Extended Echo Ranging (EER) the forward scattering echo detection algorithms. Complete acquisition of scale-model threat target scattering databases and assess robustness of target scattering features to environmental distortion.

FY 2004 PLANS:

- **Non-Acoustic ASW/Data Fusion Technology**
  Continue:
  - Project to miniaturize DADS sensor and control nodes by a factor of 10 with equal or better performance for littoral ASW applications.
  Complete:
  - Development of ultra-low power electronics to support advanced ASW maritime remote sensing devices.
- **Active Undersea Signal Processing**
  Initiate:
  - Development of signal processing algorithms for multistatic sonar systems that have controllable transmit waveform type and ping schedule leading to improved detection and tracking of submarine targets.
  Continue:
  - Development of signal processing algorithms that reduce the number of clutter-generated false alerts, thereby improving the ability to detect weak submarine echoes.
  - Development of signal processing techniques for detection, classification and localization of threat submarines using coherent sources in a multistatic sonar system.
  - Development of improved signal processing techniques for use with multistatic sonar systems that employ explosive sound sources.
  Complete:
  - Performance evaluation of a multistatic sonar system using air-deployed explosive sound sources and sonobuoys based on an operational concept called “non-traditional scattering”.
- **Air and Deployable ASW Sensors/Systems**
  Initiate:
  - Development of encoded Low Probability of Intercept (LPI) transmit acoustic waveforms for use with multistatic active sources. The intent is to ensure enemy submarines remain unaware they are operating inside a multistatic sensor field.
  Continue:
  - Development of computational intelligence algorithms aimed at efficiently and effectively activating a multistatic field of air-deployed sources and receivers.
  - Development of the technology to enable Telesonar acoustic communications for deployable systems.
  Complete:
  - An assessment exploring the feasibility of using acoustic intensity sensors as active receivers for ASW applications.
  - Development of volumetric arrays for deployables capable of tactically significant gains.
- **Multistatic ASW (Component of LASW FNC)**
  Initiate:

- At-sea testing of the integrated multistatic sonar system, comprised of the signal processing software, "field-level" processing, the Compact Deployable Multistatic Receiver and the Compact Deployable Multistatic Source.

Continue:

- Development and testing of signal processing software for the Compact Deployable Multistatic Receiver. Each software "build" incrementally increases the amount of processing performed in the sonobuoy and decreases the amount of data that needs to be transmitted to the command center.
- Development of small, cheaper low-frequency active source transducers for use in Navy multistatic sonar systems.
- Development of "field-level" processing that combines data provided by many Compact Deployable Multistatic Receivers distributed across a large ocean region, and produce tracks of submarines moving through the region.
- Research to optimize in-situ multi-static active sonar performance based on broadband, physics-based scattering models and environmental feedback algorithms.

Complete:

- Transducer, power source and power amplifier development and integration for the new aircraft-deployable Compact Deployable Multistatic Source.
- Development and at-sea testing of Compact Deployable Multistatic Receiver hardware and software.

FY 2005 PLANS:

- **Non-Acoustic ASW/Data Fusion Technology**

Initiate:

- Development of an advanced mobile node design for DARWIN (DADS Advanced Research for Wireless Instrumented Networks) ASW applications.

Continue:

- Project to miniaturize DADS sensor and control nodes by a factor of 10 with equal or better performance for littoral ASW applications.

Complete:

- Design of a prototype node that will resist damage from trawling/fishing equipment.

- **Active Undersea Signal Processing**

Continue:

- Development of signal processing algorithms for multistatic sonar systems that have controllable transmit waveform type and ping schedule leading to improved detection and tracking of submarine targets.
- Development of signal processing algorithms that reduce the number clutter-generated false alerts, thereby improving the ability to detect weak submarine echoes.

- Development of signal processing techniques for detection, classification and localization of threat submarines using coherent sources in a multistatic sonar system.

Continue:

- Development of improved signal processing techniques for use with multistatic sonar systems that employ explosive sound sources.

- **Air and Deployable ASW Sensors/Systems**

Continue:

- Development of encoded LPI transmit acoustic waveforms for use with multistatic active sources. The intent is to ensure enemy submarines remain unaware they are operating inside a multistatic sensor field.
- Development of the technology to enable Telesonar acoustic communications for deployable systems.
- Development of computational intelligence algorithms aimed at efficiently and effectively activating a multistatic field of air-deployed sources and receivers.

- **Multistatic ASW (Component of LASW FNC)**

Continue:

- At-sea testing of the integrated multistatic sonar system, comprised of the signal processing software, "field-level" processing, the Compact Deployable Multistatic Receiver and the Compact Deployable Multistatic Source.
- Research to optimize in-situ multi-static active sonar performance based on broadband, physics-based scattering models and environmental feedback algorithms.

Complete:

- Development and testing of signal processing software for the Compact Deployable Multistatic Receiver. Each software "build" incrementally increases the amount of processing performed in the sonobuoy and decreases the amount of data that needs to be radioed back to the command center.
- Development of improved, small-size, less expensive, low-frequency, active source transducers for use in Navy multistatic sonar systems. Development of "field-level" processing that combines data provided by many the outputs of a Compact Deployable Multistatic Receivers distributed across a large ocean region, and produce tracks of submarines moving through the region.

	FY02	FY03	FY04	FY05
Battlegroup Anti-Submarine Warfare (ASW) Defense	30,356	26,545	26,161	27,850

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 2002 ACCOMPLISHMENTS:

- **Non-Acoustic ASW and Data Fusion Technology**

  Continued:
  - Sea tests of optical standoff sensor systems.
  - Design and integration of an Ultra Low Frequency/Extremely Low Frequency (ULF/ELF) Electromagnetic (EM) submarine Multi-Mode Magnetic Detection System (MMMDS) mounted on Vertical Take-off Unmanned Autonomous Vehicles (VTUAVs).

- **Active Undersea Signal Processing**

  Initiated:
  - Development of signal processing techniques that combine multiple waveforms from echo returns before tracks are formed. This effort has the potential to improve detection performance and holding times for surface ship sonar systems.

  Continued:
  - Development of signal processing improvements for coherent tactical active sonar systems aimed at improving the ability to detect, classify and locate small, slow moving submarines in shallow water environments.
  - Investigation of synthetic aperture sonar techniques for improving target and clutter classification performance in tactical ASW sonar systems operating in shallow water environments.
  - Investigations into time-reversal techniques that exploit the diversity of the shallow water underwater acoustic channel to improve the performance of active sonar systems.

  Completed:
  - Ultra-wide waveform target strength model-based measurements and associated modeling.

- **Platform Sensors and Arrays**

  Initiated:
  - Evaluation of Reduced Diameter fiber optic sensors to improve towed array reliability.
  - Development of sensors and algorithms to address degradation of towed array performance during operational maneuvers and turns.
  - Research to design high frequency, high dynamic-range fiber optic acoustic sensors.
  - Research to develop the virtual sonar array concept for any hull-mounted sonar (e.g., submarine, autonomous underwater vehicle, torpedo).

  Continued:
  - Development of conformal hull array designs of significantly greater aperture and reduced volume and weight for application to the high frequency sail array designs for 688- and Virginia-class submarines.
  - Development of low cost Fishline fiber optic array for platform-deployed ASW-sensors.
  - Fabricated and tested the response of long sections of polymer coated fibers.

  Completed:

- Development of Volumetric (multi-line) towed array aperture control; multi-line array transitioned the Advanced Systems Technology Office (ASTO), SEA-93, P.E. 0603561N.

- **Acoustic Sources and Materials**

  Initiated:
  - Development of compact, broadband, high frequency cymbal arrays that will provide greater than one octave transmit capability above 10 kHz for conformal array applications.

  Continued:
  - Development of structural magnetostrictive materials to enable more rugged acoustic transducer designs capable of explosive shock survivability and useable as structural members in innovative transducers.

- **High Frequency Broadband Transducer and Arrays for Submarines (Component of Littoral Anti-Submarine Warfare (LASW) Future Naval Capability (FNC)).**

  Initiated:
  - Development of outboard power electronics and controls for conformal arrays with a highly reliable and low-profile design.

  Continued:
  - Development of in-situ calibration techniques to monitor large conformal arrays.

  Completed:
  - Development of the Magnetostrictive Piezoelectric Transducer (MPT) array for the High Frequency (HF) conformal program that can deliver high power over a 2+ octave frequency band.
  - Development of HF broadband panel projector array for the HF conformal array with the capability of velocity control over the entire frequency band of operation.
  - Development of broadband hybrid transducer array for the Ballistic Missile Submarine (SSBN) program. Demonstrated this more reliable, modern replacement transducer on an SSBN test platform.

- **Environmentally Adaptive (EA) AN/SQQ-89 (Component of LASW FNC)**

  Continued:
  - Development of technical approaches for automating the operational configuration of sonar systems in response to real-time analysis of the acoustic field and relevant (measured) environmental parameters to reduce operator workload, enable reduced manning, and improve performance in littoral environments.
  - Testing of environmentally adaptive signal processing techniques in multiple fleet operational efforts.

  Completed:
  - Transition of environmentally adaptive processing development for non-Gaussian background noise.

- **Sonar Automation (Component of LASW FNC)**

  Initiated:
  - Sonar automation technology development plan to be used as a long-term master plan for the 6-year Sonar Automation Program.

- Development and demonstration of signal processing algorithms designed to 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 passive sonar systems.

- **Limits of Passive Sonar (Component of LASW FNC)**

Initiated:

- Passive acoustic array test-bed design and hardware component procurement to support future passive sonar system designs.

- **Counter Torpedo Detection, Classification, and Localization (CTDCL) (Component of LASW FNC)**

Initiated:

- System requirements definition for the AN/WSQ-11 "Tripwire" system that will protect surface ships from torpedo salvo attacks.
- Hardware risk-reduction efforts for the AN/WSQ-11 "Tripwire" to protect surface ships from torpedo salvo attacks.

FY 2003 PLANS:

- **Non-Acoustic ASW and Data Fusion Technology**

Continue:

- Optical standoff sensor platform installation and performance testing.
- Design and integration of the MMMDS mounted on VTUAVs.

Complete:

- Sea tests of optical standoff sensor systems.

- **Active Undersea Signal Processing**

Initiate:

- Development of improved techniques to distinguish submarine echoes from echoes produced by ocean bottom features using an understanding of the reflective properties of the ocean bottom and its underlying geologic foundation.

Continue:

- Development of signal processing improvements for coherent tactical active sonar systems aimed at improving the ability to detect, classify and locate small, slow moving submarines in shallow water environments.
- Investigation of synthetic aperture sonar techniques for improving target and clutter classification performance in tactical ASW sonar systems operating in shallow water environments.
- Investigations into time-reversal techniques that exploit the diversity of the shallow water underwater acoustic channel to improve the performance of active sonar systems.

Complete:

- Development of signal processing techniques that combine multiple waveforms from echo returns before tracks are formed. This effort has the potential to improve detection performance and holding times for surface ship sonar systems.

- **Passive Undersea Signal Processing**

Initiate:

- Development and evaluation of advanced sonar signal classification algorithms, using "support vector machines," that allow sonar system operators to compensate for local noise conditions and therefore improve their performance.

- **Platform Sensors/Arrays**

Initiate:

- Development of Vector Sensor Line Array with piezocrystal vector sensors for improved signal-to-noise and bandwidth.
- Development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Development of a geo-acoustic inversion capability for submarines that uses data from the submarine's passive towed array.

Continue:

- Development of Reduced Diameter fiber optic sensor to improve towed array reliability.
- Development of sensors and algorithms to address degradation of towed array performance during operational maneuvers and turns.
- Fabrication of low cost Fishline fiber optic array for platform-deployed ASW-sensors.
- Assembly and laboratory measurements of a large aperture virtual sonar array.
- Fabrication and calibration of individual high frequency fiber optic sensors.
- Development of conformal hull array designs of significantly greater aperture and dramatically reduced volume and weight for application to the high frequency sail array designs for 688- and Virginia-class submarines.

Complete:

- Fabrication and field-testing of the performance of a complete polymer coated fiber array.

- **Acoustic Sources and Materials**

Initiate:

- Design and development of underwater projectors utilizing structural magnetostrictive material.
- Development of baffled ring transducer technology.

Continue:

- Development of structural magnetostrictive materials to enable more rugged acoustic transducer designs capable of explosive shock survivability and useable as structural members in innovative transducers.
- Development of compact, high frequency cymbal transducer (a Class V flextensional transducer) for inclusion into a thin conformal array less than one-half inch thick.

- Development of Lead Zirconate Titanate materials under high field DC biased operation as a means to improve high power performance and linearity under high power operation with at least double the power output of ordinary piezoelectric materials.

- **High Frequency Broadband Transducer and Arrays for Submarines (Component of LASW FNC)**
  Initiate:
  - Testing of prototype candidate transducer arrays for down-select and development of final array test plans.
  Continue:
  - Development of outboard power electronics and controls for conformal arrays with a highly reliable and low-profile design.
  Complete:
  - Development of in-situ calibration techniques to monitor large conformal arrays.
  - Testing of prototype candidate transducer arrays for down-select to a prototype array contract.
- **EA AN/SQQ-89 (Component of LASW FNC)**
  Complete:
  - Development of technical approaches for automating the operational configuration of sonar systems in response to real-time analysis of the acoustic field and relevant (measured) environmental parameter.
  - Testing of environmentally adaptive signal processing techniques in multiple fleet operational efforts.
  - Development of EA AN/SQQ-89 signal processing techniques.
- **Sonar Automation (Component of LASW FNC)**
  Continue:
  - Development and demonstration of signal processing algorithms designed to detect and classify acoustic signatures of threat submarines.
  - Characterization of undersea threat signals and clutter to be used to design new signal processing algorithms for submarine and surveillance passive sonar systems.
  Complete:
  - Sonar automation technology development plan to be used as a long-term plan for the 6-year Sonar Automation Program.
- **Limits of Passive Sonar (Component of LASW FNC)**
  Continue:
  - Passive acoustic array test-bed design and hardware component procurement to support future passive sonar system designs.
- **Counter Torpedo Detection, Classification, and Localization (CTDCL) (Component of LASW FNC)**
  Initiate:
  - Development of signal processing and system control algorithm for the AN/WSQ-11 “Tripwire” torpedo protection system.

- Development of an AN/WSQ-11 "Tripwire" testbed for the testing of signal processing and system control algorithms.
-

Continue:
- System requirements definition for the AN/WSQ-11 "Tripwire" system that will protect surface ships from torpedo salvo attacks.
- Hardware risk-reduction efforts for the AN/WSQ-11 "Tripwire" to protect surface ships from torpedo salvo attacks.

FY 2004 PLANS:

- **Non-Acoustic ASW and Data Fusion Technology**

Initiate:
- Advanced algorithm development for MMMDS.

Continue:
- Design and integration of the MMMDS mounted on VTUAVs.

Complete:
- Prototype MMMDS design.

- **Active Undersea Signal Processing**

Initiate:
- Development of active sonar signal processing techniques for surface ship sonar systems to detect, classify and localize torpedoes and autonomous underwater vehicles.

Continue:
- Development of improved techniques to distinguish submarine echoes from echoes produced by ocean bottom features using an understanding of the reflective properties of the ocean bottom and its underlying geologic foundation.
- Development of signal processing improvements for coherent tactical active sonar systems aimed at improving the ability to detect, classify and locate small, slow moving submarines in shallow water environments.
- Investigation of synthetic aperture sonar techniques for improving target and clutter classification performance in tactical ASW sonar systems operating in shallow water environments.
- Investigations into time reversal techniques that exploit the diversity of the shallow water underwater acoustic channel to improve the performance of active sonar systems.

Passive Undersea Signal Processing

Initiate:

- Concept development of sonar system automation technologies that automatically guide system operators through the complicated sequence operations required to detect, classify and track threat submarines.

Complete:

- Development and evaluation of advanced sonar signal classification algorithms, using "support vector machines," that allow sonar system operators to compensate for local noise conditions and therefore improve their performance.

- **Platform Sensors/Arrays**

Continue:

- Development of Reduced Diameter fiber optic sensor to improve towed array reliability.
- Development of sensors and algorithms to address degradation of towed array performance during operational maneuvers and turns.
- Development of a Vector Sensor Line Array with piezocrystal vector sensors for improved signal-to-noise and bandwidth.
- Development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Development of a geo-acoustic inversion capability for submarines that uses data from the submarine's passive towed array. Demonstrate geo-acoustic inversion using own ship noise.

Complete:

- Testing of low cost Fishline fiber optic array for platform-deployed ASW-sensors.
- At-sea testing and evaluation of Vector Sensor Line Array with piezocrystal vector sensors for improved signal to noise and bandwidth.
- Development of Conformal Hull Array designs of significantly greater aperture and reduced volume and weight for application to high frequency sail array designs for the 688- and Virginia-class submarines. Transition to the Advanced Systems Technology Office (ASTO), SEA-93, Program Element 0603561N.
- Fabrication and calibration of individual high frequency fiber optic sensors, and testing the high frequency acoustic array in the lab and in a field demonstration.
- Assembly and laboratory measurements of a large aperture virtual sonar array.

- **Acoustic Sources and Materials**

Initiate:

- Development of a hybrid sensor to detect both acoustic and magnetic signatures.
- Development of miniature underwater sources and sensors that mimic biological processes for use in small Unmanned Underwater Vehicles (UUVs).

Continue:

- Design and development of underwater projectors using structural magnetostrictive materials.
- Development of structural magnetostrictive materials to enable more rugged acoustic transducer designs capable of explosive shock survivability and useable as structural members in innovative transducers.
- Development of baffled ring transducer technology.

Complete:

- Development of compact, high frequency cymbal transducers for inclusion into a thin conformal array less than one-half inch thick.

- **High Frequency Broadband Transducer and Arrays for Submarines (Component of LASW FNC)**
  This effort has been terminated. Final analysis and documentation will be developed as part of Program Element 0603747N.
- **Sonar Automation (Component of LASW FNC)**
  Continue:
  - Development and demonstration of signal processing algorithms designed to detect and classify acoustic signatures of threat submarines.
  - Characterization of undersea threat signals and clutter to be used to design new signal processing algorithms for submarine and surveillance sonar systems.
- **Limits of Passive Sonar (Component of LASW FNC)**
  Complete:
  - Passive acoustic array test-bed design and hardware component procurement to support future passive sonar system designs.
- **Counter Torpedo Detection, Classification, and Localization (CTDCL) (Component of LASW FNC)**
  Continue:
  - Development of signal processing and system control algorithm for the AN/WSQ-11 "Tripwire" torpedo protection system.
  - Development of an AN/WSQ-11 "Tripwire" testbed for the testing of signal processing and system control algorithms.

  Complete:
  - System requirements definition for the AN/WSQ-11 "Tripwire" system that will protect surface ships from torpedo salvo attacks.
  - Hardware risk-reduction efforts for the AN/WSQ-11 "Tripwire" to protect surface ships from torpedo salvo attacks.

FY 2005 PLANS:

- **Non-Acoustic ASW and Data Fusion Technology**
  Initiate:
  - Testing of the MMMDS on VTAUVs.

  Continue:
  - Advanced algorithm development for the MMMDS.

  Complete:
  - Testing of the prototype MMMDS design.
- **Active Undersea Signal Processing**

Initiate:
- Development of an integrated solution to environmentally adaptive signal processing, incorporating environmental sensing, adaptive transmit waveforms, and receive signal processing.

Continue:
- Development of active sonar signal processing techniques for surface ship sonar systems to detect, classify and localize torpedoes and autonomous underwater vehicles.
- Development of improved techniques to distinguish submarine echoes from echoes produced by ocean bottom features using an understanding of the reflective properties of the ocean bottom and its underlying geologic foundation.
- Development of signal processing improvements for coherent tactical active sonar systems aimed at improving the ability to detect, classify and locate small, slow moving submarines in shallow water environments.

Complete:
- Investigation of synthetic aperture sonar techniques for ASW tactical towed array applications.
- Investigations into time reversal techniques that exploit the diversity of the shallow water underwater acoustic channel to improve the performance of active sonar systems.

- **Passive Undersea Signal Processing**

Complete:
- Concept development of sonar system automation technologies that automatically guide system operators through the complicated sequence operations required to detect, classify and track threat submarines.

- **Platform Sensors/Arrays**

Initiate:
- Development of low cost, compact, combined acoustic sensor.

Continue:
- Development of low cost, compact, fiber-laser acoustic motion sensor.
- Development of Vector Sensor Line Array with piezocrystal vector sensors fro improved signal-to-noise and bandwidth.
- Development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Development of a geo-acoustic inversion capability for submarines that uses data from the submarine's passive towed array. Demonstrate using an operational Navy asset.

Complete:
- Evaluation of Reduced Diameter fiber-optic sensor to improve towed array reliability. Transition to the Advanced Systems Technology Office (ASTO), SEA-93, Program Element 0603561N.
- Evaluation of sensors and algorithms to address degradation of towed array performance during operational maneuvers and turns. Transition to the Advanced Systems Technology Office (ASTO), SEA-93, Program Element 0603561N.

- **Acoustic Sources and Materials**

Continue:
- Development of miniature underwater sources and sensors that mimic biological processes for use in small UUVs.
- Development of structural magnetostrictive materials to enable more rugged acoustic transducer designs capable of explosive shock survivability and useable as structural members in innovative transducers.
- Development of baffled ring transducer technology.

Complete:
- Design and development of underwater projectors using structural magnetostrictive materials.
- Development of a hybrid sensor to detect both acoustic and magnetic signatures.

- **Limits of Passive Sonar (Component of LASW FNC)**

Initiate:
- Focused research program to establish fundamental limits of passive sonar performance in shallow water using the passive acoustic array test-bed.

- **Counter Torpedo Detection, Classification, and Localization (CTDCL) (Component of LASW FNC)**

Continue:
- Development of signal processing and system control algorithm for the AN/WSQ-11 "Tripwire" torpedo protection system.
- Development of an AN/WSQ-11 "Tripwire" testbed for the testing of signal processing and system control algorithms.

	FY02	FY03	FY04	FY05
Neutralization	25,947	23,415	18,759	20,431

This effort includes:

- **Counterweapon/Countermeasure** effort develops technologies that will increase the probability of survival for surface and submarine platforms against torpedo threats.
- **Explosives and Undersea Warheads** effort develops technologies with significant enhancement in capabilities over current technologies.
- **Non-Traditional Homing (Component of Littoral Anti-Submarine Warfare (LASW) Future Naval Capability (FNC))** addresses the development of the operational utility of a stealthy torpedo detection, classification and homing sensor. This is a high risk development that holds promise for providing an improvement in probability of kill that is revolutionary.
- **Weapon Silencing** addresses noise control techniques to reduce radiated noise of torpedoes.
- **Weapon Simulation Based Design** addresses design tools and optimization methods for torpedoes.
- **Supercavitation Technology** addresses physics of supercavitation, and vehicle control and guidance for high-speed torpedo.

- **Torpedo Propulsion** addresses advanced torpedo propulsion including both electric and thermal power sources. This effort also addresses the Office of Naval Research (ONR) propulsion program for high-speed supercavitating weapons focusing on power sources based on water-combustion of hydro-reactive metallic fuels.
- **Weapon Guidance and Control** includes advanced waveforms (e.g. low-probability-of-intercept waveforms), detection algorithms, adaptive canceling algorithms, frequency-domain beamforming, adaptive normalization, target-angle estimation, target classification, acoustic arrays, auxiliary non-acoustic sensors, algorithms for exploiting multi-sensor data (data fusion), and algorithms for mission planning and weapon control.
- **Weapon/Platform Connectivity (Component of LASW FNC)** develops technologies to dramatically improve tactical control for submarine-on-submarine engagements by increasing torpedo placement accuracy, improving target detection probability, and enhancing torpedo homing fidelity.
- **SwampWorks Advanced Torpedo (SAT)** effort develops technologies to meet emerging challenges of low Doppler, small targets (diesel submarines), in harsh littoral environments.

FY 2002 ACCOMPLISHMENTS:

- **Counterweapon/Countermeasure**
  Continued:
  - Development of technologies for terminal defense against close-in waterborne/underwater threats and high-speed weapons.
  Completed
  - Transfer of technology development for Anti-Torpedo Torpedo (ATT) and Next Generation Countermeasure (NGCM) to Fleet/Force Protection FNC (F/FP FNC).
- **Explosive and Undersea Warheads**
  Continued:
  - Development of directed energy concept proof of principle for enhanced performance undersea warhead. Development of this advanced concept will permit enhanced performance torpedo warheads in reduced volumes.
  - Development of concepts and design tools for enhanced kill mechanisms of Undersea Warheads. Development of these tools will permit the elimination of several iterations of empiricism's in the design and testing cycle with significant cost and time savings.
  Completed:
  - Development of underwater explosive effects hydrocode that provides computational methods to accurately evaluate the effects of damage resulting from underwater explosions.
  - Development of Micro Electro-Mechanical Systems (MEMs) Safing and Arming (S&A) technology. This capability permits reduction of size and cost of future torpedo S&A systems by up to 90%.
- **Non-Traditional Homing**
  Continued:

- Development of a non-traditional torpedo homing concept to provide a robust adjunct homing capability - including proof of concept in-water, pier-side testing of an alternative sensor.

- **Weapon Silencing**
  Continued:
  - Development of a low noise integrated motor propulsor entitled Low Acoustic Signature Motor/Propulsor for Electrically Powered Undersea Vehicles (LAMPrEy) to enhance weapon silencing.
  - Development of an Active Noise Control technology that reduces vehicle shell vibration and noise radiation using Active Fiber Composite materials.
  - Development of active-passive mount technologies for reducing weapon machinery noise by conducting laboratory experiments and demonstrations.

  Completed:
  - Development of torpedo noise modeling and incorporated it into the Undersea Weaponry Design and Optimization (UWDO) design toolbox.
  - In-water demonstration of smart skin torpedo noise radiation control concepts.
- **Weapon Simulation Based Design**
  Continued:
  - Development of UWDO tools using physics based models, computational techniques, and codes to optimize undersea weapon system designs with respect to cost and performance requirements.

  Completed:
  - Development of design architecture and tools for 6.25 inch weapon, and transitioned design tools to Naval Under Warfare Center's (NUWC) Electric Lightweight Torpedo.
- **Supercavitation Technology**
  Continued:
  - Development of high-speed supercavitating torpedo vehicle control and homing sensor. Continue to conduct experiments and tests on vehicle control concepts and homing sensors.

  Completed:
  - Development of simulation codes for high-speed supercavitating torpedo. Conducted first free-running 4-inch vehicle testing in water.
- **Torpedo Propulsion**
  Continued:
  - Research on high power propulsion technologies and integrated hybrid power systems for advanced undersea weapons that reduce life-cycle costs, increase power and energy densities, and enhance stealth. Efforts include models for hybrid propulsion systems, high power rechargeable batteries, micro-turbines, and hydro-reactive materials.
- **Weapons Guidance and Control**
  Continued:

- Development of innovative adaptive broadband signal processing algorithms that will improve a torpedo's single-ping detection, classification and localization performance. This initiative investigated signal processing advancements made in the radar community.
- Development of technologies to support connectivity between torpedo and platform sensors. This included generation of a fire-control-quality track by combining information from multiple platform sensors, communication between a torpedo and platform-sensor nodes in motion, and guidance of the torpedo using platform-sensor information to defeat countermeasures and threat evasive maneuvers.

- **Weapon/Platform Connectivity**

  Continued:
  - Development of technologies to enable a Heavyweight torpedo and a shooting platform to be effectively employed as a fully linked on-board and off-board sensor system.

  Completed:
  - A favorable assessment of the value of alternative torpedo intelligent controller technologies relative to the controller employed in current Fleet heavyweight torpedos.

- **SwampWorks Advanced Torpedo (SAT)**

  Initiated:
  - Development of a next-generation prototype heavyweight torpedo (SwampWorks Advanced Torpedo) effective in meeting new challenges of low Doppler, small targets (diesel submarines), in the harsh littoral environments.

  Completed:
  - Development and demonstration of the feasibility of the advanced half-length torpedo via a series of subsystem and vehicle demonstrations.
  - Demonstration of vehicle self noise, stability and control, and proof-of-concept littoral upgrade to the MK 48 advanced capability (ADCAP) sonar as well as broadband recording system

FY 2003 PLANS:

- **Counterweapon/Countermeasure**

  Continue:
  - Development of technologies for terminal defense against close-in waterborne/underwater threats and high-speed weapons.

- **Explosive and Undersea Warheads**

  Continue:
  - Development of directed energy concept proof of principle for enhanced performance undersea warhead. Development of this advanced concept will permit enhanced performance torpedo warheads in reduced volumes.
  - Development of concepts and design tools for enhanced kill mechanisms of Undersea Warheads. Development of these tools will permit the elimination of several iterations of empiricism's in the design and testing cycle with significant cost and time savings.

- **Non-Traditional Homing**
  Continue:
  - Development of a non-traditional torpedo homing concept to provide a robust adjunct homing capability - including proof of concept in-water testing of an alternative sensor and associated detection and tracking algorithms on a submarine.
- **Weapon Silencing**
  Initiate:
  - Conduct in-water testing of integrated motor propulsor-- LAMPrEy.

  Continue:
  - Development of a low noise integrated motor propulsor project entitled LAMPrEy to further enhance the Torpedo Stealth effort.
  - Development of affordable noise control concepts for machinery and propulsor radiated noise.

  Complete:
  - Development of active-passive mounts for reducing weapon machinery noise.
  - Active controller hardware implementation in Active Fiber Composites effort.
- **Weapon Simulation Based Design**
  Continue:
  - Development of a Weapon Design and Optimization capability in a virtual environment using results of FY01 and FY02 efforts.
  - Implementation of Multidisciplinary Design Optimization (MDO) in weapon design.
  - Optimization of undersea weapon system designs with respect to cost and performance requirements.

  Complete:
  - Warhead and Guidance & Control sections design using UWDO tools.
- **Supercavitation Technology**
  Initiate:
  - In-water testing of 4-inch vehicle with vehicle control devices and homing sensors.

  Continue:
  - Development of high-speed supercavitating torpedo vehicle control and homing sensors.
  - Experiments and tests on vehicle control concepts and homing sensors.

  Complete:
  - Computational Fluid Dynamics (CFD) codes development and vehicle simulation.
- **Torpedo Propulsion**
  Continue:
  - Research on high power propulsion technologies and integrated hybrid power systems for advanced undersea weapons that reduce life-cycle costs, increase power and energy densities, and enhance stealth. Efforts include concepts development for hybrid propulsion systems, high power rechargeable batteries, micro-turbines, and hydro-reactive materials.

- **Weapons Guidance and Control**
  Initiate:
  - Development of improved modeling and simulation capabilities, including improved threat models, torpedo system models and acoustic environment simulation. Establish Navy-wide modeling standards for the development, maintenance and testing of software.

  Continue:
  - Development of innovative adaptive broadband signal processing algorithms that will improve a torpedo's single-ping detection, classification and localization performance. This initiative will investigate signal processing advancements made in the radar community.
  - Development of technologies to support connectivity between torpedo and platform sensors. This will include generation of a fire-control-quality track by combining information from multiple platform sensors, communication between a torpedo and platform sensor nodes in motion, and guidance of the torpedo using platform sensor information to defeat countermeasures and threat evasive maneuvers.
- **Weapon/Platform Connectivity**
  Continue:
  - Development of technologies to enable a Heavyweight torpedo and a shooting platform to be effectively employed as a fully linked on-board and off-board sensor system.

  Complete:
  - Development of a high communications bandwidth fiber optic link between a submarine firing platform and a torpedo.
- **SwampWorks Advanced Torpedo (SAT)**
  Continue:
  - Development of a next-generation prototype heavyweight torpedo (SwampWorks Advanced Torpedo) effective in meeting new challenges of low Doppler, small targets (diesel submarines), in the harsh littoral environments.

  Completed:
  - Development of the fully functional sonar and signal processing system.
  - Development of a new rechargeable electric propulsion system for the weapon.

FY 2004 PLANS:

- **Counterweapon/Countermeasure**
  Continue:
  - Development of technologies for terminal defense against close-in waterborne/underwater threats and high-speed weapons.
- **Explosive and Undersea Warheads**
  Initiate:
  - Development of MEMS Inertial Measuring Unit (IMU) into the S&A. This will permit the reduction of the safe standoff distance required for a quick reaction weapon without any own-ship safety compromise.

Continue:
- Development of directed energy concept proof of principle for enhanced performance undersea warhead. Development of this advanced concept will permit enhanced performance torpedo warheads in reduced volumes.
- Development of concepts and design tools for enhanced kill mechanisms of Undersea Warheads. Development of these tools will permit the elimination of several iterations of empiricism's in the design and testing cycle with significant cost and time savings.

- **Non-Traditional Homing**

Initiate:
- Proof of concept in-water testing of a second alternative sensor and associated detection and tracking algorithms on a submarine.

Continue
- Development of a non-traditional torpedo homing concept to provide a robust adjunct homing capability.

Complete:
- Proof of concept in-water testing of an alternative sensor and associated detection and tracking algorithms on a submarine

- **Weapon Silencing**

Continue:
- Development of a low noise integrated motor propulsor project entitled LAMPrEy to further enhance the Torpedo Stealth effort.
- In-water testing of integrated motor propulsor—LAMPrEy.
- Development of affordable noise control concepts for machinery and propulsor radiated noise.

- **Weapon Simulation Based Design**

Continue:
- Development of a Weapon Design and Optimization capability in a virtual environment.
- Implementation of MDO in weapon design.
- Optimization of undersea weapon system designs with respect to cost and performance requirements.

- **Supercavitation Technology**

Continue:
- In-water testing of 4-inch vehicle with vehicle control devices and homing sensors.
- Development of high-speed supercavitating torpedo vehicle control and homing sensor.
- Experiments and tests on vehicle control concepts and homing sensors.

- **Torpedo Propulsion**

Continue:
- Research on high power propulsion technologies and integrated hybrid power systems for advanced undersea weapons that reduce life-cycle costs, increase power and energy densities, and enhance stealth. Efforts include concepts development for hybrid propulsion systems, high power rechargeable batteries, micro-turbines, and hydro-reactive materials.

- **Weapons Guidance and Control**
  Continue:
  - Development of innovative adaptive broadband signal processing algorithms that will improve a torpedo's single-ping detection, classification and localization performance.
  - Development of technologies to support connectivity between torpedo and platform sensors. This will include generation of a fire-control-quality track by combining information from multiple platform sensors, communication between a torpedo and platform sensor nodes in motion, and guidance of the torpedo using platform sensor information to defeat countermeasures and threat evasive maneuvers.
  - Development of improved modeling and simulation capabilities, including improved threat models, torpedo system models and acoustic environment simulation. Establish Navy-wide modeling standards for the development, maintenance and testing of software.
- **Weapon/Platform Connectivity**
  Continue:
  - Development of technologies to enable a Heavyweight torpedo and a shooting platform to be effectively employed as a fully linked on-board and off-board sensor system.
  Complete:
  - A high fidelity concept of operations assessment of competing technologies being developed in this project.
- **SwampWorks Advanced Torpedo (SAT).**
  Continue:
  - Development of a next-generation prototype heavyweight torpedo (SwampWorks Advanced Torpedo) effective in meeting new challenges of low Doppler, small targets (diesel submarines), in the harsh littoral environments.
  Complete:
  - Demonstration of fully functional sonar and signal processing suite integrated within the fleet guidance and control section, and demonstrated in open water firings.
  - Demonstration of tactical benefit of a wakeless, quiet propulsion system.
  - Generate performance and cost models for evaluation in fleet acquisition and ownership models.

FY 2005 PLANS:

- **Counterweapon/Countermeasure**
  Continue:
  - Development of technologies for terminal defense against close-in waterborne/underwater threats and high-speed weapons.
- **Explosive and Undersea Warheads**
  Continue:
  - Development of directed energy concept proof of principle for enhanced performance undersea warhead. Development of this advanced concept will permit enhanced performance torpedo warheads in reduced volumes.

- Development of concepts and design tools for enhanced kill mechanisms of Undersea Warheads. Development of these tools will permit the elimination of several iterations of empiricism's in the design and testing cycle with significant cost and time savings.
- Development of MEMS IMU into the S&A. This will permit the reduction of the safe standoff distance required for a quick reaction weapon without any own-ship safety compromise.

- **Non-Traditional Homing**
  Continue:
  - Development of a non-traditional torpedo homing concept to provide a robust adjunct homing capability - including upgrading the initial detection and tracking algorithms.
  Complete:
  - Proof of concept in-water testing of a second alternative sensor and associated detection and tracking algorithms on a submarine.
- **Weapon Silencing**
  Continue:
  - Development of affordable noise concepts for machinery and propulsor radiated noise.
  Complete:
  - Development and in-water testing of integrated motor propulsor— LAMPREY.
- **Weapon Simulation Based Design**
  Continue:
  - Development of a Weapon Design and Optimization capability in a virtual environment.
  - Implementation of MDO in weapon design.
  - Optimization of undersea weapon system designs with respect to cost and performance requirements.
- **Supercavitation Technology**
  Continue:
  - In-water testing of 4-inch vehicle with vehicle control devices and homing sensors.
  - Development of high-speed supercavitating torpedo vehicle control and homing sensor.
  - Experiments and tests on vehicle control concepts and homing sensors.
- **Torpedo Propulsion**
  Continue:
  - Research on high power propulsion technologies and integrated hybrid power systems for advanced undersea weapons that reduce life-cycle costs, increase power and energy densities, and enhance stealth. Efforts include concepts development for hybrid propulsion systems, high power rechargeable batteries, micro-turbines, and hydro-reactive materials.
- **Weapons Guidance and Control**
  Continue:

- Development of technologies to enable a heavyweight torpedo and a shooting platform to be effectively employed as a fully linked on-board and off-board sensor system.
- Development of innovative adaptive broadband signal processing algorithms that will improve a torpedo's single-ping detection, classification and localization performance.
- Development of technologies to support connectivity between a torpedo and platform sensors. This will include generation of a fire-control-quality track by combining information from multiple platform sensors, communication between a torpedo and platform sensor nodes in motion, and guidance of the torpedo using platform sensor information to defeat countermeasures and threat evasive maneuvers.
- Development of improved modeling and simulation capabilities, including improved threat models, torpedo system models and acoustic environment simulation. Establish Navy-wide modeling standards for the development, maintenance and testing of software.

- **Weapon/Platform Connectivity**
  Continue:
  - Development of technologies to enable a Heavyweight torpedo and a shooting platform to be effectively employed as a fully linked on-board and off-board sensor system including down-selecting between competing applied research approaches to fully coherent broadband processing to enable focusing of advanced development efforts.
- **SwampWorks Advanced Torpedo (SAT)**
  Complete:
  - In-water demonstration of SAT.

	FY02	FY03	FY04	FY05
Project Morgan	2,885	1,705	0	0

Details are of a higher classification.

Congressional Plus-Ups:

	FY02	FY03
Acoustic Temperature Profiler	0	2,494

Improve 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 would improve ATP measurement sensitivity across a wider range of depths, thereby increasing the accuracy of the SVP.

	FY02	FY03
Lithium Carbon Monofluoride Battery	0	977

Conduct research into new Lithium Carbon Monofluoride Battery types and applications, to raise the operating temperature and to develop ultra-thin coin cells. This program would develop an advanced lithium/carbon monofluoride (Li/CFx) battery, containing a relatively low toxicity electrolyte and a safer, higher energy CFx cathode material which makes possible twice the mission time of naval mines and surveillance systems, versus present lithium batteries.

	FY02	FY03
Low Acoustic Signature Motors	0	2,054

Provide applied research to Low Acoustic Signature Motor/Propulsor for Electrically Powered Undersea Vehicles (LAMPREY) technology development. Modifications would be made to the propulsor/control surfaces/after body of the water tunnel test hardware; and the modified hardware would be installed on an at-sea test vehicle. The vehicle would be instrumented to measure propulsor shaft speed, motor operating conditions, and vibration of the propulsor and vehicle hull to help interpret radiated noise measurement results. The results would be reduced and interpreted to ascertain noise sources and levels to compare to water tunnel measurements, and to compare to design and performance prediction results.

	FY02	FY03
Magnetorestrictive Transduction	0	5,282

Conduct research involving magnetorestrictive materials and their uses. Effort focuses research to advance the state-of-the-art of giant magnetorestrictive materials in several areas to include: developing better methods of producing Galfenol materials; quantifying variability in TERFENOL-D production and the resulting impact to transducer designs; and integrating and testing at sea the Multiband transducer array on a WLD-1 Remote Minehunting Vehicle.

	FY02	FY03
SAUVIM	*0	1,662

*$1,644 (Appropriated in FY02 in PE 0602633N)

Semi-Autonomous Underwater Vehicle for Intervention Missions (SAUVIM): 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.

	FY02	FY03
	FY02	FY03
Undersea Defensive Warfare Systems (6.25 ATT Technology)	0	1,173

Develop technology to 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, and to meet speed and range requirements set forth by the AN/WSQ-11 Tripwire Torpedo Defense System acquisition program, into which this technology will transition.

	FY02	FY03
Undersea Defensive Warfare Systems (Rapid Response ATT Weapon)	0	1,173

Expand 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 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602782N
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Mine and Expeditionary Warfare Applied Research	54,379	55,531	47,490	48,315	47,692	50,431	51,345	52,329

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) provides technologies for naval Mine Countermeasures (MCM), U.S. Naval sea mines, Naval Special Warfare, 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. The PE supports the Joint Littoral Warfare Mission Area 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 thrusts concentrate on the development and transition of technologies for the Organic Mine Countermeasures Future Naval Capability (OMCM FNC) 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 thrust emphasizes technologies for future sea mines. The Naval Special Warfare and EOD technology thrust concentrates on the development of technologies for near-shore mine/obstacle detection and clearance, mobility and survivability, as well as explosive ordnance disposal. 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 “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.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602782N
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Applied Research

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	57,158	56,813	56,354	54,599
Adjustments from FY 2003 President's Budget:				
NWCF Rate Adjustment			-105	-2
SBIR Reduction	-721			
Execution Adjustment	-1,780			
Congressional Rescissions/Adjustments/Undist Reductions	-278	-680		
Efficiencies at NWCF Activities			-614	-641
S & T Program Adjustments			-7,049	-4,599
Inflation Adjustments		-602	-1,096	-1,042
FY 2004/2005 President's Budget Submission:	54,379	55,531	47,490	48,315

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602782N Project Title: Mine and Expeditionary Warfare Applied Research
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Applied Research

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Mine and Expeditionary Warfare Applied Research	54,379	55,531	47,490	48,315	47,692	50,431	51,345	52,329

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project provides technologies for naval Mine Countermeasures (MCM), U.S. Naval sea mines, Naval Special Warfare, 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. The project supports the Joint Littoral Warfare Mission Area 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 effort concentrate on the development and transition of technologies for organic mine countermeasures and Future Naval Capabilities supporting Ship to Objective Maneuver. 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 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. 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 “STOM key transformational capability” within “Sea Strike”.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Mine/Obstacle Detection	33,663	34,260	32,550	31,177

Nations that threaten the US have the capability to procure, stockpile and rapidly deploy, throughout the littoral battlespace, all types of naval mines, including new generation mines that have sophisticated performance characteristics. Advanced technologies are required to rapidly detect and neutralize all mine types, from deep water to the beach. The activity includes: remote sensing techniques to survey threat mining activities and mine/obstacle field locations; advanced acoustic/non-acoustic sensors and processing technologies (e.g. biomimetic,

broadband, synthetic aperture, multi/hyperspectral) for rapid minefield reconnaissance and determination of the location of individual mines and obstacles.

FY 2002 ACCOMPLISHMENTS:

- Acoustic Sensors: Demonstrated the employment of reconnaissance and mine hunting autonomous underwater vehicles (AUVs)from a High Speed Vessel and mine countermeasures ship as part of spiral development for Fleet Battle Experiment Juliet. Demonstrated reacquisition of AUV detected contacts by a mine countermeasures ship sonar. Demonstrated reconnaissance and mine hunting autonomous underwater vehicles (AUVs) from a High Speed Vessel during Fleet Battle Experiment Joliet, demonstrating long endurance (15 hours) autonomous operation. Initiated development of forward looking sonar for AUV obstacle avoidance. Conducted low frequency, broadband synthetic aperture sonar (SAS) field tests to acquire data for concept assessment and development of processing algorithms. Initiated development of long range SAS motion compensation and beamforming. Began integration of low frequency, broadband SAS hardware onto an Autonomous Underwater Vehicle (AUV). Initiated development of buried mine classification sensor.
- Electro-optic Sensors: Initiated collection/characterization of active/passive electro-optic mine signature data in coastal marine environments. Initiated real-time processing for airborne laser ranging/multi-spectral minefield detection (LIDAR). Completed development of high pulse rate laser for minefield detection. Refined optical performance predictive model for on-scene assessment of diver visibility. Began transition of sensor and predictive model for on-scene assessment of diver visibility.
- Image Processing, Classification Algorithms, and Data Fusion: Initiated transition of automated mine identification algorithms to AQS-20A airborne mine countermeasures program. Continued development and refinement of automated mine identification algorithms. Initiated development of environmental tactical decision aids. Continued development of environmentally adaptive processing techniques to extend detection/classification range of existing and emerging sensor systems. Refined broad band processing techniques/algorithms using at sea data acquired from low frequency, broadband SAS field-testing. Continued development of mine burial prediction algorithms, focusing on scour modeling and the incorporation of oceanographic data. Conducted mine burial prediction field experiment focusing on burial by wave induced scour. Developed a threat evaluation software module to accurately estimate the threat posed to transiting ships by multiple threat mine types in multiple lanes. Initiated development of an automated deconfliction manager for use during ship to shore mission planning.

FY 2003 PLANS:

- Acoustic Sensors: Demonstrate autonomous reconnaissance and mine hunting technologies, during Fleet exercise such as Transparent Hunter 2003, focusing on multiple cooperating vehicles. Continue development of obstacle avoidance sonar for AUVs. Complete development and assess performance of long range SAS motion compensation and beamforming techniques using existing SAS field data. Complete integration of low frequency, broadband SAS hardware onto AUV. Conduct at sea testing to quantify performance and collect data to refine low frequency, broadband-processing techniques. Continue development of buried mine classification sensor. Begin to address AUV integration issues for buried mine classification sensor.
- Electro-optic Sensors: Complete the collection and characterization of active/passive electro-optic mine signature data in coastal marine sediments. Refine real-time processing algorithms for airborne LIDAR/multi-spectral minefield detection utilizing active/passive signature data. Complete and validate electro-optic identification (EOID) system performance models.
- Image Processing, Classification Algorithms, and Data Fusion: Complete refinement of automated mine identification algorithms. Complete the transition of automated mine identification algorithms to AQS-20A airborne mine countermeasures program. Begin long-range, automated target recognition physics-based algorithms for Synthetic Aperture Sonar. Begin integration of mine burial predictive models into expert system tactical decision aid and demonstrate model in large experiment.

FY 2004 PLANS:

- Acoustic Sensors: Continue development and demonstration of autonomous reconnaissance and mine hunting technologies focusing on multiple cooperating vehicles. Complete development of obstacle avoidance sonar for AUVs. Complete SAS algorithm development for long-range, multi-path environment. Continue data collection to refine low frequency broadband processing techniques. Continue development of obstacle avoidance sonar and real-time path planning algorithms. Begin development of compact low frequency, broadband projector, improved low frequency, broadband synthetic aperture receiver and post mission analysis tool for AUV system integration. Begin integration of buried mine classification sensor into an AUV.
- Electro-optic Sensors: Demonstrate validity and utility of EOID system performance models and diver visibility models during a fleet exercise. Continue the development of active/passive electro-optic image processing and modeling to support Rapid Overt Airborne Reconnaissance - including factoring in results of the previous phenomenology studies in the Surf Zone (SZ) and Beach Zone (BZ).
- Image Processing, Classification Algorithms, and Data Fusion: Continue development of SAS physics-based algorithms for automated target recognition at long ranges. Complete the incorporation of mine burial model code into expert system and Mine Warfare Decision Aids Library (MEDAL); conduct major burial experiments at Martha’s Vineyard.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602782N Project Title: Mine and Expeditionary Warfare Applied Research
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Applied Research

FY 2005 PLANS:

- Acoustic Sensors: Complete data collection to refine low frequency broadband processing techniques. Complete development of obstacle avoidance sonar and real-time path planning algorithms for UUVs. Complete development of compact broadband projector, improved broadband synthetic aperture receiver and post mission analysis tool for AUV system integration. Demonstrate autonomous reconnaissance and minehunting technologies, specifically broadband low frequency sonar, during fleet exercise. Initiate multi-static AUV-based minehunting system development integrating navigation, communication and sensor elements. Complete integration of buried mine classification sensor into AUV. Begin field trials of buried mine classification.
- Electro-optic Sensors: Transition of EOID system performance models and sensors and models for on-scene assessment of diver visibility. Continue development of systems and algorithms for airborne detection of buried land minefields in anticipation of a major demonstration in FY 07.
- Image Processing, Classification Algorithms, and Data Fusion: Continue development of SAS physics-based algorithms for automated target recognition at long ranges. Initiate effort to fuse data from magnetic and acoustic sensors to enhance probability of classification (Pc) and reduce false alarm rate for buried minehunting. Transition mine burial expert system to the Naval Oceanographic Office.

	FY 02	FY 03	FY 04	FY 05
Mine/Obstacle Neutralization	9,539	9,398	4,200	5,800

This activity includes influence sweeping technologies for influence minefield clearance, explosive and non-explosive technologies for mine/obstacle field breaching, and advanced technologies to rapidly neutralize shallow water (SW) sea mines. The overall goal of these first two activities is to reduce mine countermeasures (MCM) tactical timelines and increase standoff.

FY 2002 ACCOMPLISHMENTS:

- Surf Zone (SZ) Mine Neutralization: Initiated development of computational tools to be used to predict the performance of dart dispenser mechanisms. Initiated development of a sand penetration model to be used to predict the performance of darts and fragments against buried mines. Extended mine vulnerability database to include damage from reactive and chemical darts for beach zone mines. Initiated assessment of chemical and reactive dart lethality against common SZ and beach zone (BZ) mines. Began analysis of assault lane navigation system by conducting field test to determine accuracy, required self-survey time, and temporal stability using fixed land and sea beacon nodes.
- Obstacle Breaching: Completed the assessment of explosive channeling as a mechanism for clearing mines and obstacles in the surf zone. Continued the development of the Surface Neutralization

Bomblets (SNUBs) concept for obstacle clearance. Conducted initial analysis of the effectiveness of segmented rod warhead against light and beach obstacles. Initiated development of a fragmenting warhead concept for mine and obstacle clearance.

- Sea Mine Neutralization: Initiated mine jamming concept utilizing ship-degaussing coils. Conducted field demonstration and initiated assessment of mine jamming concepts utilizing mine countermeasures vessel (MCMV) ship-degaussing coils during a NATO exercise.

FY 2003 PLANS:

- SZ Mine Neutralization: Continue development of computational tools to be used to predict the performance of dart dispenser mechanisms. Continue development of dart and fragment sand penetration model. Continue to expand mine vulnerability database to include damage from reactive and chemical darts against surf zone mines. Continue assessment of dart lethality against SZ and BZ mines with an emphasis on chemical, reactive, and explosive fills. Continue assault lane navigation system analysis and perform feasibility demonstration of precise positional reference system using fixed land and sea beacon nodes. Assess advanced standoff mine neutralization technologies.
- Obstacle Breaching: Continue analysis of the effectiveness of segmented rod warhead against light and medium beach obstacles. Continue development of a fragmenting warhead concept for mine and obstacle clearance. Continue assessment of advanced obstacle breaching technologies.
- Sea Mine Neutralization: Complete assessment of mine jamming concepts utilizing MCMV ship-degaussing coils.

FY 2004 PLANS:

- SZ Mine Neutralization: Continue assessment of dart dispenser concepts using advanced computational tools and engineering level models. Complete development of a penetration model for projectiles and fragments - emphasis on sand. Continue development of mine vulnerability database - emphasis on kinetic damage, shock, blast and thermal effects. Continue assessment of advanced mine neutralization technologies - emphasis on standoff weapons. Initiate development of mine vulnerability code for surf zone (SZ) and beach zone (BZ) mines.
- Obstacle Breaching: Complete development of segmented rod warhead for light and medium obstacles. Continue development of computational tools for the assessment of advanced obstacle breaching technologies - emphasis on standoff weapons e.g. continuous rod warhead (CRW) and guided bombs. Initiate development of advanced computational model to simulate guided bombs in the surf zone against light and medium obstacles.

- Sea Mine Neutralization: Begin application of mine jamming concepts utilizing ship-degaussing coils to steel hulled vessels.

FY 2005 PLANS:

- SZ Mine Neutralization: Continue development of the mine vulnerability database for kinetic damage, shock, blast and thermal effects. Continue assessment of advanced standoff mine neutralization technologies. Continue development of a mine vulnerability code for surf zone (SZ) and beach zone (BZ) mines.
- Obstacle Breaching: Continue development of advanced computational tools to explore continuous rod warhead (CRW) and guided bomb technologies. Complete development of an advanced computational model to simulate guided bombs in the surf zone against light and medium obstacles. Continue assessment of advanced standoff obstacle breaching technologies.
- Sea Mine Neutralization: Initiate development of advanced laser targeting and advanced fire control algorithms for Rapid Airborne Mine Clearance System (RAMICS), focusing on deeply submerged targets of interest. Conduct demonstration and assessment of mine jamming utilizing ship-degaussing coils during a fleet exercise.

	FY 02	FY 03	FY 04	FY 05
Mine Technology:	1,156	200	200	200

The requirement for improved sea mine technologies stems from a threat from third world submarines and surface ships, which may be encountered in the littoral waters. Despite the diminished sophisticated threat, it is imperative that the US Navy maintain a broad-based and robust sea mining capability through advanced mine sensors, environmental characterization, and systems performance analysis technologies. Emphasis is placed on potentially high payoff advanced sensors for target detection and discrimination and on low cost, wide area sea mine system concepts, including positive command/control mechanisms and expanded weapon effectiveness for regional warfare.

FY 2002 ACCOMPLISHMENTS:

- Completed analysis/documentation of guidance sensors and signal processing field tests. Completed development of command and control hardware/software for minefield control. Field-tested the command and control of Distributed Advanced Deployable System (DADS) weapon.

FY 2003 PLANS:

- Initiate and complete development of mining assessment tools. Initiate assessment of advanced sea mine technologies focusing on remote control and warhead concepts for increased effectiveness.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602782N Project Title: Mine and Expeditionary Warfare Applied Research
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Applied Research

FY 2004 PLANS:

- Continue assessment of advanced sea mine technologies focusing on remote control and warhead concepts for increased effectiveness.

FY 2005 PLANS:

- Initiate assessment of advanced sea mine technologies focusing on target classification, tracking and fire control from networked, distributed mine sensors.

	FY 02	FY 03	FY 04	FY 05
Special Warfare/EOD	10,021	11,673	10,540	11,138

Naval Special Warfare (NSW) missions primarily support covert near-shore naval operations. The goal is to develop technology required to increase the combat range and effectiveness of Special Warfare units. A major current 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) approaches to the amphibious landing areas. Improvements to mission support equipment are needed to increase the probability of mission success, endurance and SEAL swimmer survivability. Technology developments for Explosive Ordnance Disposal (EOD) address DOD Joint Service and interagency responsibilities. The technologies are required for locating, rendering safe and disposing of Unexploded Explosive Ordnance (UXO) and those required to counter and neutralize Weapons of Mass Destruction (WMD). EOD operations typically occur in deep, poor-visibility water, in areas of high background noise, and in strategic operating areas contaminated by a variety of UXO. Advanced technologies are needed for gaining access to areas contaminated by sophisticated area-denial sensors and/or booby traps. These technologies are expected to transition to the Joint Service EOD Program, the Naval EOD Program or the DOD Technical Response Group.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602782N Project Title: Mine and Expeditionary Warfare Applied Research
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Applied Research

FY 2002 ACCOMPLISHMENTS:

- NSW/EOD Sensor Technology: Completed fabrication of diver portable dual frequency lens sonar. Continued development of hyperspectral polarometer prototype. Continued development of small synthetic aperture sonar for UUV deployment. Continued development of digital beamformer architecture for high frequency imaging sonar. Continued development of shallow water real time imaging polarometer. Completed development of technologies to remotely jam or disable the functioning of Electronic Safed Armed fused devices. Continued development of short range sensors for UUV reconnaissance of surf zone. Continued development of a pulsed elemental analysis with neutrons system for identification of filler material in improvised explosive devices.
- NSW/EOD Mission Support Technology: Completed analysis of mass transfer characteristics for catalyst free CO2 scrubber. Continued development of life support equipment technologies. Initiated development of miniature CO2 sensor. Initiated development of passively controlled rebreather. Continued development of technologies to enable coordinated behavior and mission execution by unmanned underwater vehicles. Continued development of robotic manipulators and actuators based on artificial muscle materials. Continued development of virtual environment-based training aid and tactical decision aids for NSW missions. Continued development of unmanned underwater vehicle (UUV) technologies to support VSW and SZ reconnaissance missions. Began investigation of methods to increase service lifetime of underwater adhesives.

FY 2003 PLANS:

- NSW/EOD Sensor Technology: Complete development of shallow water real time imaging polarometer. Complete development of small synthetic aperture sonar for UUV deployment. Complete development of hyperspectral polarometer prototype. Continue development of digital beamformer architecture for high frequency imaging sonar. Perform field tests on dual frequency lens sonar. Continue development of short range sensors for UUV reconnaissance of surf zone. Continue development of a pulsed elemental analysis with neutrons system for identification of filler material in improvised explosive devices. Initiate development of standoff detection and classification sensors for surface and buried UXO using multi-dimensional electro-magnetic (EM) methods.
- NSW/EOD Mission Support Technology: Continue development of robotic manipulators and actuators based on artificial muscle materials. Continue development of life support equipment technologies. Continue development of miniature CO2 sensor. Continue development of passively controlled rebreather. Continue development of virtual environment-based training aid and tactical decision aids for NSW missions. Continue development of UUV technologies to support VSW reconnaissance missions. Complete development of technologies to enable coordinated behavior and mission execution

by unmanned underwater vehicles. Proceed with development of extended lifetime underwater adhesives. Begin investigation of technology alternatives for next generation Seal Delivery Vehicle.

FY 2004 PLANS:

- NSW/EOD Sensor Technology: Complete development of digital beamformer architecture for high frequency imaging sonar. Continue development of short range sensors for UUV reconnaissance of surf zone. Complete development of a pulsed elemental analysis with neutrons system for identification of filler material in improvised explosive devices. Continue development of standoff detection and classification sensors for surface and buried UXO using multi-dimensional EM methods. Begin development of buried ordnance identification sensor.
- NSW/EOD Mission Support Technology: Complete development of robotic manipulators and actuators based on artificial muscle materials. Complete analysis of low order detonation phenomena. Complete development of miniature CO2 sensor. Complete development of passively controlled rebreather. Complete development of virtual environment-based training aid and tactical decision aids for NSW missions. Continue development of UUV technologies to support VSW reconnaissance missions. Continue development of extended lifetime underwater adhesives. Develop design alternatives for next generation Seal Delivery Vehicle. Begin development of technology to provide blast mitigation for detonations in congested areas. Begin development of Ultra High Velocity Shaped Charge for neutralizing improvised explosive devices.

FY 2005 PLANS:

- NSW/EOD Sensor Technology: Complete development of short range sensors for UUV reconnaissance of surf zone. Continue development of standoff detection and classification sensors for surface and buried UXO using multi-dimensional EM methods. Continue development of buried ordnance identification sensor. Begin development of sensor to detect radioactive material underwater.
- NSW/EOD Mission Support Technology: Continue development of technology to provide blast mitigation of explosions in congested areas. Continue development of Ultra High Velocity Shaped Charge for neutralizing improvised explosive devices. Begin development of low signature materials for application to NSW and EOD tools and clothing.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0601153N (Defense Research Sciences)
PE 0602131M (Marine Corps Landing Force Technology)

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602782N Project Title: Mine and Expeditionary Warfare Applied Research
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Applied Research

PE 0602435N (Ocean and Atmospheric Technology Applied Research)
PE 0603502N (Surface and Shallow Water Mine Countermeasures)
PE 0603654N (Joint Service Explosive Ordnance Development)
PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)
PE 0604654N (Joint Service Explosive Ordnance Development)
PE 0603640M (Marine Corps Advanced Technology Demo)

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 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602805N
PROGRAM ELEMENT Title: Dual Use Science and Technology Program

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Dual Use Science and Technology Program	9,003							

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The mission of the Dual Use Science and Technology (DUS&T) Program is to prototype and demonstrate new approaches for leveraging commercial research, technology, products, and processes for military benefit. These new approaches to working with industry, many of which were prototyped at DARPA, must become common throughout the Navy in order to take full advantage of the technological dynamism of the commercial sector. While acquisition reform has helped clear the path, and experience has shown leveraging can work; it has also shown that leveraging is still unfamiliar and not widely adopted. The challenge is to spread leveraging of the commercial sector into the Navy and make it a normal way of doing business throughout the entire acquisition spectrum. Specifically, DUS&T encourages the Navy to leverage commercial research and development to improve the performance, cost and/or readiness of military systems. Under this effort, the Navy solicits, evaluates, ranks, and nominates dual use S&T projects for Dual Use S&T funds. Each project is 50% cost shared with industry. 25% is cost shared with the Navy project funds and Dual Use S&T provides the remaining 25%. All projects are awarded using either Cooperative Agreements or Other Transactions. This is essentially learning by doing approach to Dual Use S&T in the Navy, with Dual Use S&T funds providing an incentive.

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

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President’s Budget Submission:	12,489	0	0	0
SBIR	-2,927			
Execution Adjustment	-506			
Cong. Rescissions/Adjustments/Undist Reductions	-53			
FY 2004/2005 President’s Budget Submission	9,003	0	0	0

PROGRAM CHANGE SUMMARY EXPLANATION:

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602805N
PROGRAM ELEMENT Title: Dual Use Science and Technology Program

Schedule: Not applicable
Technical: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602805N
PROGRAM ELEMENT: Dual Use Science and Technology Program
Project Title: Dual Use Science and Technology Program

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Dual Use Science and Technology Program	9,003							

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The mission of the Dual Use Science and Technology (DUS&T) project was to prototype and demonstrate new approaches for leveraging commercial research, technology, products, and processes for military benefit. These new approaches to working with industry, many of which were prototyped at DARPA, must become common throughout the Navy in order to take full advantage of the technological dynamism of the commercial sector. The challenge was to spread leveraging of the commercial sector into the Navy and make it a normal way of doing business throughout the entire acquisition spectrum. Specifically, DUS&T encouraged the Navy to leverage commercial research and development to improve the performance, cost and/or readiness of military systems. Under this effort, the Navy solicited, evaluated, ranked, and nominated dual use S&T projects for Dual Use S&T funds. Each project was 50% cost shared with industry. 25% was cost shared with the Navy project funds and Dual Use S&T provided the remaining 25%. All efforts were awarded using either Cooperative Agreements or Other Transactions. This was essentially a learning by doing approach to Dual Use S&T in the Navy, with Dual Use S&T funds providing an incentive.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Dual Use Science and Technology	6,504	-	-	-

FY 2002 ACCOMPLISHMENTS: This project investigated technological advances with possible applications toward solution of specific Naval problems, short of a major development effort.

Continued: The following efforts were supported:

- Advanced Dual Use Propulsion technologies development for manned and unmanned vehicles
- Turbine Blade technologies development
- 500kW Integrated Fuel Processor development
- Qualification of Ausform Finishing Process for the Manufacturing of Aerospace Gearing
- A System for Distributed Registration for Mobile Augmented Reality in Urban Environment
- Linear Wide-Band Vacuum Electronic Power Amplifier Multi-Frequency Design Codes for Linear High Power Amplifiers
- High Power Silicon Carbide Transmitter

- Dynamically Reconfigurable and Scalable Distributed Shipboard Automation System for Improved Sustainability and Survivability
- High Power Density Integrated Motor-Propulsors and Electric Machines
- Reconfigurable Control and Fault Identification System

Completed:

- Intelligent Inference Systems Bio-Bots

FY 2003 PLANS: Not Applicable

FY 2004 PLANS: Not Applicable

FY 2005 PLANS: Not Applicable

Congressional Plus-Ups:

	FY 02	FY 03
Energy and Environmental Technology	2,499	0

Tested to examine engineering associated with optimal performance and durability. Focused on making advances in durability performance and cost reduction and moving rapidly toward commercialization

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
Various S&T PE's supporting the 25% level dual use requirement
NON NAVY RELATED RDT&E:
0602805A Dual Use Science and Technology
0602802F Dual Use Science and Technology

NAVY RELATED RDT&E:

NON-NAVY RELATED RDT&E:

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 2 PROGRAM ELEMENT: 0602805N Project Title: Dual Use Science and Technology Program
PROGRAM ELEMENT: Dual Use Science and Technology Program

D. ACQUISITION STRATEGY: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603114N
PROGRAM ELEMENT TITLE: Power Projection Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2487 Aircraft Affordability Project DP-2	5,380	4,890						
R2721 Vectored Thrust Ducted Propeller (VDTP)	3,273	3,423						
R2821 Integrated Hypersonic Aeromechanics Tool Program (IHAT)	2,613	3,657						
R2823 Precision Strike Navigator	1,738	977						
R2911 Power Projection Advanced Technology	79,235	76,521	177,006	190,411	104,445	67,529	48,809	49,691
R3006 Affordable Weapons	6,724	5,867						
R9008 HEL-Low Aspect Target Tracking	8,070	4,451						
R9009 Aircraft Lightening Protection Applique System	1,442							
R9010 Variable Deliverable Pump/Variable Engine Nozzle	1,442	1,467						
R9011 Thermobaric Warhead Development	2,017							
R9012 Magdalena Ridge Observatory	8,146	20,536						
R9013 Littoral Support Craft (LSC (X))	0	8,935						
R9133 Advanced Camouflage Coating Demonstration	0	7,066						
R9134 High Speed Anti-Radiation Missile Demonstration – Digital CAS	0	7,481						
R9135 High Speed Anti-Radiation Missile Demonstration – AARGM	0	6,161						
R9136 HYSWAC Lifting Body Development	0	5,886						
R9137 Littoral Support Craft (LSC (X)) – Lifting Body	0	9,873						

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603114N
PROGRAM ELEMENT TITLE: Power Projection Advanced Technology

Total	120,080	167,191	177,006	190,411	104,445	67,529	48,809	49,691

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION:
This program includes RDT&E,N funds to develop and demonstrate advanced technologies for naval weapon systems, including Directed Energy, and Electric Warship related efforts which provide enhanced lethality and enable new capabilities for locating, identifying and killing high-value, short-dwell military ground and undersea targets, and suppression of enemy defenses. These technologies will include those that minimize exposure of naval personnel to lethal fire (autonomous vehicles), and reduce the total ownership cost of systems. This Program Element 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.

B. PROGRAM CHANGE SUMMARY:
PROGRAM CHANGE SUMMARY EXPLANATION:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	117,756	78,247	69,511	53,166
Adjustments from FY 2003 President’s Budget:				
Congressional Plus-Ups		92,715		
SBIR Reductions	-2,388			
Execution Adjustments	+5,284			
Cong. Rescissions/Adjustment/Undist. Reductions	-572	-1,956		
S&T Program Adjustments			+111,792	+141,490
NWCF Rate Adjustments			-75	-34
Efficiencies at NWCF Activities			-136	-105
Pay Raise/Inflation Adjustments		-1,815	-4,086	-4,106
FY 2004/2005 President’s Budget Submission:	120,080	167,191	177,006	190,411

Schedule: Not applicable
Technical: Not Applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603114N Project Number: R2911
PROGRAM ELEMENT TITLE: Power Projection Advanced Technology Project Title: Power Projection Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2911 Power Projection Advanced Technology	79,235	76,521	177,006	190,411	104,445	67,529	48,809	49,691

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION:
This program includes RDT&E,N funds to develop and demonstrate advanced technologies for naval weapon systems, including Naval Unmanned Combat Air Vehicle (UCAV-N), Directed Energy, and Electric Warship related efforts which provide enhanced lethality and enable new capabilities for locating, identifying and killing high-value, short-dwell military ground and undersea targets, and suppression of enemy defenses. These technologies will include those that minimize exposure of naval personnel to lethal fire (autonomous vehicles) and reduce the total ownership cost of systems. This Project includes elements of the following Future Naval Capabilities (FNCs): Time Critical Strike (TCS), Autonomous Operations (AO), and Total Ownership Cost (TOC).

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
TIME CRITICAL STRIKE***	45,193	34,191	67,944	76,586

In support of this overall mission the following specific areas are included:
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. Time Critical Strike must address time sensitive targets in complex urban areas over crowded skies shared by civilian commercial and neutral country aircraft. High quality, timely sensor information, target identification, and course of action analysis is required to enable distributed collaborative planning and the generation of retargeting folders for strike platforms.

All TCS technologies reduce the time to conduct strike in all functional areas of the kill chain: detect, decide, engage, and battle damage assessment. Intelligence processing, execution speed, command decisions, and accuracy of

strike are in constant tension. Technologies in this functional area also include those associated with Littoral Support Craft (Experimental) and directed energy.

FY 2002 Accomplishments:

This activity is associated with the Future Naval Capability (FNC) of Time Critical Strike (TCS) as well as other Exploitation and Deployment efforts. The TCS FNC is focused on delivering capability enhancements across detect, decide, engage and assess sub-systems to acquisition programs for transition to Fleet systems. The TCS FNC accomplished:

- Real Time Execution Decision Support System (REDS): Initiated system level and detailed design of software methods for collaborative planning, options generation, and mission target folder generation.
- Low Cost Active Terminal Seeker development for Cruise Missile Real Time Retargeting (CMRTR). Risk reduction test included flight testing of V.2 sensor. Development of V.3 sensor included signal and image processing and weapon interface in accordance tactical TOMAHAWK performance requirements.
- Gathered target data sets and conducted image and video analysis (IVA) algorithm survey and develop methods for target exploitation in image and video streams.
- Developed chemical and mechanical processes for low cost Fiber Optic Gyroscope inertial measurement unit fabrication as part of Precision Strike Navigator (PSN).
- Conducted integrated studies of an advanced dual mode anti-radiation missile seeker incorporating novel seeker, aperture, guidance and control technologies for a ramjet-powered missile airframe. This program will lead to a flight test demonstration of seeker Anti-Radiation Missiles effectiveness at high-speed (HSARM).
- Hyper-spectral Imaging System (HSI): Initiated development of rugged, high through-put near and far Infra-Red Spectrometers, optical train analysis, select position/pointing system reference, and enhanced detect algorithms for real time processor
- Surveyed candidate designs and began scale tests to develop a targetable submunition warhead variant for Tomahawk while preserving unitary performance Mission Responsive Ordnance (MRO).

The Exploitation and Deployment efforts for the Time Critical Strike activity include advanced rocket motor technology for high-speed strike weapons, advanced weapons seeker and guidance programs, hypersonic dual-combustor laboratory testing for high-speed air-breathing strike weapon, and tactical targeting processors which will be demonstrated to quantify specific risks remaining to achieve accurate and lethal strike

missions. Focused efforts on evaluation/assessment of high-speed vessel for long range, stable, affordable weapon support of expeditionary operations were conducted.

FY 2003 Plans:

This effort continues with significant efforts associated with the Future Naval Capability (FNC) of Time Critical Strike (TCS) as well as other Exploitation and Deployment efforts. The TCS FNC efforts are:

- Initiate design concepts and scaled material testing for advanced gun projectile propulsion technology and associated Advanced Gun-Barrel Technology (AGT).
- Mission Responsive Ordnance (MRO) technology will develop targetable submunition warhead variant for Tomahawk while preserving unitary performance, focusing on kill vehicle definition and operation and support structure.
- Real Time Execution Decision Support System (REDS): Detailed design and code software for collaborative planning, options generation, and mission target folder generation.
- Complete test and evaluation of V.2 sensor, continue development of V.3 sensor, spec V.4 low cost terminal seeker for Cruise Missile Real Time Retargeting (CMRTR).
- Conduct image video analysis (IVA) algorithm survey and develop algorithms for target exploitation in image and video streams on data sets collected.
- Within the Precision Strike Navigator (PSN) effort, continue development of chemical and mechanical processes, accuracy and stability testing for low cost Fiber Optic Gyroscope inertial measurement unit.
- High-Speed Anti-Radiation Missiles (HSARM) effort: Continue integrated studies and initiate development of an advanced dual mode anti-radiation missile seeker incorporating novel seeker, aperture, guidance and control technologies for a ramjet-powered missile airframe.
- Hyper-spectral Imaging System (HSI): Develop and complete rugged, high through-put near and far Infra-Red Spectrometers, optical train analysis, select position/pointing system reference, and enhance detect algorithms for real time processor.

The Exploitation and Deployment efforts for the Time Critical Strike functional area include:

- For the HyFly effort, begin fabrication of prototype components (Formed intlet cowl, inlet housing, Gas generator housing, and combustor nozzle).

FY 2004 Plans:

This effort continues with significant efforts associated with the Future Naval Capability (FNC) of Time Critical Strike (TCS) as well as other Exploitation and Deployment efforts. The TCS FNC efforts are:

- Continue development and scaled testing of advanced gun projectile propulsion technology (AGT) and associated advanced Gun-Barrel Technology.
- Continue efforts on Mission Responsive Ordnance (MRO) technology to develop targetable submunition warhead variant for Tomahawk while preserving unitary performance, developing kill vehicle form, lethality, guidance and control, and design of the unitary support structure.
- Real Time Execution Decision Support System (REDS): Complete software implementation and system and unit level test for collaborative planning, options generation, and mission target folder generation.
- Continue development of V.3 and V.4 sensors for low cost terminal seeker for Cruise Missile Real Time Retargeting (CMRTR), testing subcomponents of V.3 sensor.
- Continue image video analysis (IVA) algorithm development and implementation for target exploitation in image and video streams. Begin automatic target recognition development, optimized for algorithms and the data sets chosen.
- Within the Precision Strike Navigator (PSN) effort, continue development of chemical and mechanical processes for low cost precision Fiber Optic Gyroscope inertial measurement unit, with low accuracy unit ready for evaluation.
- HSARM: Continue development and subsystem test of an advanced dual mode anti-radiation missile seeker incorporating novel seeker, aperture, guidance and control technologies for a ramjet-powered missile airframe.
- Hyper-spectral Imaging System (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 for functional flight testing and evaluation.

The Exploitation and Deployment efforts for the Time Critical Strike functional area include:

- Advanced Gun Systems for fire support will be investigated.
- In addition, lifting body technology associated with the Littoral Support Craft (Experimental) will be pursued in conjunction with Congressional Plus-up Project Number R9137 in this Program Element.
- For the HyFly effort, complete fabrication of prototype components (Formed inlet cowl, inlet housing, Gas generator housing, and combustor nozzle). Conduct sled test of booster test vehicle. Conduct flight

tests of separation test vehicle (STV), and Booster performance and submunition dispense. Complete wind tunnel tests of freejet engine. Complete assembly of first HyFly flight test vehicle and associated live energetic systems. Deliver test vehicle to test site. Complete assembly of vehicle engine and integrate with fuel tank.

- For the SSCM effort begin basic design efforts and trade studies for the Standoff High-speed Option for Counter proliferation (SHOC) task. Complete a closed design that can be carried forward into a successful flight demonstration. Complete system requirements definition. The SSCM Supersonic Turbine Demonstration (STD) task will begin studies to identify potential concepts that address performance of the first demonstration vehicle, and depict the evolution into weaponized configurations. Initiate engine preliminary design of the STD under cooperative effort with the NASA Revolutionary Turbine Accelerator project utilizing NASA Revolutionary Aero-Space Engine Research (RASER) program. Generate performance specifications. Complete preliminary flight demo vehicle design.

FY 2005 Plans:
This effort continues with significant efforts associated with the Future Naval Capability (FNC) of Time Critical Strike (TCS) as well as other Exploitation and Deployment efforts. The TCS FNC efforts are:

- Continue development and scaled testing of advanced gun projectile propulsion technology (AGT) and associated advanced Gun-Barrel Technology. Begin large scale gun prototyping with materials selected.
- Continue efforts on Mission Responsive Ordnance (MRO) technology to develop targetable submunition warhead variant for Tomahawk while preserving unitary performance, developing and rail testing scaled and full sized, semi functional kill vehicles to determine lethality, fusing, guidance and control mechanisms, and unitary support structure.
- Full system test of V.3 sensor, continue development of V.4 sensor for low cost terminal seeker for Cruise Missile Real Time Retargeting (CMRTR), integrating V.2, V.3 sensors with V.4 and performing V.4 subsystem tests.
- Complete image video analysis (IVA) algorithms and implementation for target exploitation in image and video streams on target system. Incorporate automatic target recognition software, optimized for algorithms and the data sets chosen on target system.
- Complete development of the Precision Strike Navigator (PSN) chemical and mechanical processes for low cost precision Fiber Optic Gyroscope inertial measurement unit, with 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 incorporating novel seeker, aperture, guidance and control technologies for a ramjet-powered missile airframe. Complete HSARM system level effectiveness testing.

The Exploitation and Deployment efforts for the Time Critical Strike functional area include:

- Complete assembly and deliver 2nd and 3rd HyFly flight test vehicles to test site. Conduct free flight tests of all three flight test vehicles and submit a report for each flight test.
- For the SSCM SHOC effort begin propulsion and payload subsystem development and testing. Missile subsystem development and test will begin, to include propulsion, airframe, ordnance, and guidance & control subsystems. For the STD effort initiate inlet/engine/nozzle integration and testing. Begin engine ground testing. Begin installation of the first flight engine. Continue fabrication of flight vehicles.

	FY 02	FY 03	FY 04	FY 05
Naval-Unmanned Combat Air Vehicle(UCAV-N)	9,080	25,000	95,105	99,797

In partnership with the Defense Advanced Research Projects Agency (DARPA), Naval Unmanned combat air vehicles (UCAV-N) will be investigated to effectively and affordably prosecute strike and surveillance missions. The UCAV-N approach must be responsive in that it can reduce the strike timeline against time critical targets. An aggressive UCAV-N goal has been set to demonstrate the technical feasibility for a UCAV system to effectively and affordably prosecute persistent, sea-based Surveillance, Suppression of Enemy Air Defenses, and Strike missions within the FORCENET 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. Collaboration with United States Air Force (USAF) UCAV development to investigate and demonstrate joint UCAV system potential is an integral part of the demonstration.

The technical challenges of UCAV-N include: (1) Suitability of an advanced low observable air vehicle for carrier based launch and recovery, (2) integrated man/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, and deck operations.

FY 2002 Accomplishments:

- Completed initial operational system concept development trade studies, effectiveness analysis, System Maturation Plans and Preliminary Demonstration System Designs.

FY 2003 Plans:

- Conduct simulated carrier air traffic area and mission operations, perform subsystem demonstrations, and prepare for surrogate and demonstrator aircraft flight test. Explore joint Air Force/Navy UCAV system potential. Update operational system concept based on results.

FY 2004 Plans:

- Continue subsystem and deck operations demonstrations, continue air vehicle, surrogate, and Mission Control System (MCS) software development (H/W and S/W Critical Design Review (CDR) is planned), fabricate two flight demonstration systems, develop surveillance mission simulations.

FY-2005 Plans:

- Continue fabrication and checkout of two flight demonstration systems, continue air vehicle, surrogate, and MCS software development, conduct surveillance mission simulations and surrogate flight test, continue software and MCS development, prepare for shore-based catapult and arrested flight demonstrations

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	FY 02	FY 03	FY 04	FY 05
Autonomous Operations (AO)	17,242	17,330	13,957	14,028

Autonomous Operations: The autonomous operations 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 systems. By defining and focusing risk reduction overarching Intelligent Autonomy Science and Technology principles, transitional products will be developed in four areas: Unmanned Ground Vehicles (UGV) which focuses on the increasing utility of UGV systems to Marine Corps units in all environments but specifically in urban and littoral terrain; Unmanned Air Vehicles (UAV) which includes intelligent reasoning for autonomy, 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; and UAV Propulsion which will develop innovative propulsion and power technologies unique to Naval UAVs operating from surface combatants. This activity is related to on-going efforts such as the Integrated High Performance Turbine Engine Technology and planned for the Versatile Affordable Advanced Turbine Engine (VAATE) efforts after FY-05.

FY 2002 Accomplishments:

This activity is associated with the Future Naval Capability (FNC) of Autonomous Operations as well as other efforts. Autonomous Operations FNC efforts include:

- UAV Technology: For Situational Awareness, developed sub-system self-awareness sensor software to enable adaptation and independent action for detection (threats & terrain), display, and decision.
- Intelligent Autonomy: Developed alternative designs and risk reduction assessments for intelligent vehicle self-management and fault tolerance targeting concepts.
- UAV Propulsion: Continued development of an advanced propulsion system for reliable UAV systems with enhanced operational capabilities and affordable readiness. Development will be in conjunction with the joint Government and Industry Integrated High Performance Turbine Engine Technology (IHPTET) Phase III Joint Expendable Turbine Engine Concepts (JETEC) and the Joint Technology Demonstrator Engine (JTDE) class development efforts.
- UGV: Initiated design and development of mobility Unmanned Ground Vehicle (UGV) testbed for platform, sensor, and command & control sub-systems.
- UUV: Developed and demonstrated undersea, autonomous operations for Undersea Search and Survey, and Communications/Navigation Aid utilizing a network of multiple, mobile nodes. Also, developed and demonstrated undersea, autonomous operations for Maritime Reconnaissance utilizing a submarine launch-capable vehicle.

The Exploitation and Deployment efforts for the Autonomous Vehicles effort completes the fabrication and demonstration of an advanced linear motor system intended for affordable recovery of air vehicles. It demonstrated single-sided portion of linear motor recovery with a simulated aircraft recovery loading.

FY 2003 Plans:

This effort continues with significant efforts associated with the Future Naval Capability (FNC) of Autonomous Operations. The Autonomous Operations FNC includes:

- UAV Technology: For Situational Awareness, continue development of self-awareness sensor software to enable adaptation and independent action for detection (threats, terrain), display, and decision development of sub-system self-awareness sensors to enable adaptation and independent action for detection (threats & terrain), display, and decision. For Communications and Networks, develop multi-modal interface for humans to control autonomous vehicles using combination of control inputs, including speech, and touch screens. Using mixed-initiative model of autonomous control, develop the ability for a single human to control multiple vehicles.
- Intelligent Autonomy: Continue development design definition and risk reduction for intelligent vehicle self-management and fault tolerance targeting concepts. Development of architecture for combining reactive and deliberative behaviors for autonomous vehicles. Development of architecture for dynamic autonomy, allowing autonomous system to adjust level of autonomy based on environment, vehicle state and Rules of Engagement (ROE). Design a planning system that allows for autonomous vehicle to re-plan in real time based on current environmental and conditions and vehicle state.
- UAV Propulsion: Continue development of naval-unique propulsion and power technologies for future UAV systems and integrate these technologies into an enhanced next-generation commercial core for test. Development will be in conjunction with the IHPTET Phase III JETEC and JTDE project efforts.
- UGV: Continue design and development of mobility UGV test bed for platform, sensor, and command & control sub-systems
- UUV: Continue development and demonstration of undersea, autonomous operations for Maritime Reconnaissance utilizing a submarine launched capable vehicle. Continue development and demonstration of undersea, autonomous operations for Undersea Search and Survey, and Communications/Navigation Aid utilizing a network of multiple, mobile nodes.

FY 2004 Plans:

- UAV Technology: For Situational Awareness, develop and perform simulation testing of self-awareness sensor software to enable adaptation and independent action for detection (threats, terrain), display, and decision development of sub-system self-awareness sensors to enable adaptation and independent action for detection (threats & terrain), display, and decision. For Communications & Networks, continue the

development of multi-modal interface for humans to control autonomous vehicles using combination of control inputs, including speech, and touch screens.

- Intelligent Autonomy: Using mixed-initiative model of autonomous control, continue the development of the ability for a single human to control multiple vehicles. Continue the design of a planning system that allows for autonomous vehicle to re-plan in real time based on current environmental conditions and vehicle state.
- UAV Propulsion: Continue the development of an advanced propulsion system for reliable UAV systems. Ground test the enhanced next-generation commercial core. Development will be in conjunction with the IHPTET Phase III JETEC and JTDE project efforts.
- UGV: Complete design and development of mobility UGV test bed for platform, sensor, and command & control sub-systems
- UUV: Continue development and demonstration of undersea, autonomous operations for Maritime Reconnaissance utilizing a submarine launched capable vehicle. Continue development and demonstration of undersea, autonomous operations for Undersea Search and Survey, and Communications/Navigation Aid utilizing a network of multiple, mobile nodes.

FY 2005 Plans:

- UAV Technology: For Situational Awareness, complete simulation testing of self-awareness sensor software to enable adaptation and independent action for detection (threats, terrain), display, and decision development of sub-system self-awareness sensors to enable adaptation and independent action for detection (threats & terrain), display, and decision. For Communications & Networks, continue the development of multi-modal interface for humans to control autonomous vehicles using combination of control inputs, including speech, and touch screens.
- Intelligent Autonomy: Using mixed-initiative model of autonomous control, continue development of the ability for a single human to control multiple vehicles. Complete design of a planning system that allows for autonomous vehicle to re-plan in real time based on current environmental conditions and vehicle state.
- UAV Propulsion: Ground test the XTE-67/A1 UAV demonstrator engine comprised of naval unique UAV propulsion technologies integrated with the enhanced next-generation commercial core. Achieve IHPTET phase III JETEC cost goals and contribute towards the JTDE Thrust/weight and cost goals. Provide the

foundation demonstrator engine for the VAATE program. Ground test a Mach 3.5 capable expendable turbine engine for missile applications and achieve IHPTET phase III JETEC Thrust/Air Flow and cost goals.

- UUV: Complete development and demonstration of undersea, autonomous operations for Maritime Reconnaissance utilizing a submarine launched capable vehicle. Continue development and demonstration of undersea, autonomous operations for Undersea Search and Survey, and Communications/Navigation Aid utilizing a network of multiple, mobile nodes.

	FY 02	FY 03	FY 04	FY 05
Total Ownership Costs	7,720	0	0	0

Total Ownership Costs: Specific technology efforts are associated with affordability and reduction of total ownership costs for power projection systems.

FY 2002 Accomplishments:

This effort is associated with the Future Naval Capability (FNC) of Total Ownership Cost as well as other activities.

- The Total Ownership Cost FNC completed the Reconfigurable Rotor Blade system requirements and concept trade studies. In addition subsystem development of shaped memory alloy ¼ scale actuator will continue, as well as plans for system design, development and demonstration of the cost effective actuator and blade assembly.
- This effort is terminated at the completion of FY-02 tasks due to other program priorities.

The Exploitation and Deployment efforts for the Total Ownership Cost effort continued development and flight demonstration of enhanced Vectoring ESTOL Control Tailless Operation Research (VECTOR) air platform.

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.

CONGRESSIONAL PLUS-UPS

R2487	FY 02	FY 03
Aircraft Affordability Project DP-2	5,380	4,890

Aircraft Affordability Project DP-2: Continued development and evaluation of the half scale DP2 vertical takeoff aircraft. The advantage of the concept is to provide the only jet powered vertical and short takeoff multi-passenger aircraft.

R2721	FY 02	FY 03
Vectored Thrust Ducted Propeller (VTDP)	3,273	3,423

Vectored Thrust Ducted Propeller (VTDP): The VTDP is a multi-functional component that replaces a conventional tail rotor system in a helicopter. The VTDP provides anti-torque/yaw control capability with propulsion and effort vectoring control. Continued design, analysis and engineering support of the aircraft systems. Continue aircraft modifications and drive system testing at the Helicopter Transmission Testing Facility (HTTF). The prime contractor for VTDP is Piasecki Aircraft Corporation, Essington, PA. Navy efforts are focused at Naval Air Systems Command, Patuxent River, MD.

R2821	FY 02	FY 03
Integrated Hypersonic Aeromechanics Tool Program (IHAT)	2,613	3,657

Integrated Hypersonic Aeromechanics Tool Program (IHAT): Developed a multi-disciplinary optimization analysis tool for Navy use in design and evaluation of a hypersonic weapon system. Complete design and validation of Build One. Define requirements of next incremental Build.

R2823	FY 02	FY 03
Precision Strike Navigator	1,738	977

Precision Strike Navigator (PSN): Initiated integration of the Integrated Fiber Optic gyro components from the semi-automated fabrication facility with the goal of building and evaluating a complete Inertial Measurement Unit (IMU).

R3006	FY 02	FY 03
Affordable Weapons	6,724	5,867

Affordable Weapons: Flight-tested the Affordable Weapon from a short rail launcher using a new more powerful engine. Conduct flight duration tests of up to 6 hours. Test the GPS targeting system and demo it on a target range.

R9008	FY 02	FY 03
HEL-Low Aspect Target Tracking	8,070	4,451

HEL-Low Aspect Target Tracking: 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. Initiate laser/beam director system upgrade development and conduct test/demonstration to resolve issues associated with beam control in the negation of air threats to Surface ships. While the specific laser system of choice for the HEL ship defense application may be the electrically driven Free Electron Laser (FEL) or the Solid State Laser (SSL), this technology effort will provide essential technical data for the next phase of laser beam control at weapon power levels so laser device development can proceed with confidence.

R9009	FY 02	FY 03
Aircraft Lightening Protection Applique System	1,442	N/A

Aircraft Lightening Protection Applique System: Applied composite protection technology to small air vehicles to enhance survivability/effectiveness. This is also applicable to surface and ground based composite structures.

R9010	FY 02	FY 03
Variable Deliverable Pump/Variable Engine Nozzle	1,442	1,467

Variable Deliverable Pump/Variable Engine Nozzle (VEN): Initiate design, fabrication and demonstration testing on a new pump concept, which can be transitioned to the F-18E/F. Current nozzle actuator fuel pumps, which provide high pressure fuel to control the VEN area on the F-14 engine, have a low degree of reliability. This new pump concept will demonstrate increased reliability and durability.

R9011	FY 02	FY 03
Thermobaric Warhead Development	2,017	N/A

Thermobaric Warhead Development: Configure and demonstrate an advanced high-energy insensitive thermobaric explosive composition that will provide enhanced internal blast pressures and thermal effects in confined environments. The program will characterize and model existing foreign technologies related to thermobaric formulations, optimize compositions for US man portable munitions and determine material safety requirements. Selected compositions will be demonstrated in a variety of man portable munitions to verify concept effectiveness for final system down-selection.

R9012	FY 02	FY 03
Magdalena Ridge Observatory	8,146	20,536

Magdalena Ridge Observatory: Using a Naval Research Laboratory and New Mexico Technologic University team developed an interferometric system for use in the Magdalena Ridge Observatory to be run by New Mexico Tech.

R9013	FY 02	FY 03
Littoral Support Craft-Experimental (LSC (X))	*	8,935

Littoral Support Craft – Experimental: Littoral Support Craft – Experimental: Design and build 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 14 FEB 03, estimated deliver date 6 AUG 04)
*Previous year funding and planning discussed under PE 0603123N Project R9013.

R9133	FY 02	FY 03
Advanced Camouflage Coating Demo	0	7,066

Manufacture camouflage materials and apply them to unmanned aerial vehicles for expanded flight test evaluation, assessment and qualification. Development of 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 02	FY 03
High Speed Anti-Radiation Missile Demonstration - Digital CAS	0	7,481

This project will develop 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). This performance increase will permit engagement of a wider array of targets and will improve the effectiveness of the weapon against enemy countermeasures that have been used against current ARMs.

R9135	FY 02	FY 03
High Speed Anti-Radiation Missile Demonstration- AARGM	0	6,161

This funds the Advanced Anti-Radiation Guided Missile (AARGM) 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 02	FY 03
HYSWAC Lifting Body Development	0	5,886

Design, develop and demonstrate a Hybrid Small Waterplane Area Catamaran (HYSWAC) 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. The HYSWAC project started with an FY00 Congressional plus-up and continued to receive congressional support with FY01 and FY02 plus-ups. A complete marine survey was completed prior to the

SES-200 being towed to the conversion shipyard in Honolulu, Hawaii. Final design for conversion and initial concepts for the lifting body have been completed. The SES-200 conversion is nearing completion. Lifting body final design, construction and installation will be completed in FY03 enabling at-sea demonstration of the HYSWAC.

R9137	FY 02	FY 03
Littoral Support Craft (LSC (X)) – Lifting Body	0	9,873

Conduct underlying Science and Technology to support design and construction of a Lifting Body for the Littoral Support Craft - Experimental (a full scale vessel). Previous funding and plans for LSC (X) are discussed under PE 0603123N Project 9013.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603123N
PROGRAM ELEMENT TITLE: Force Protection Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
Force Protection Advanced Technology								
R2912 Force Protection Advanced Technology	87,869	49,808	50,620	73,903	53,137	54,242	59,535	60,295
R3049 Emerging Threats	0	6,515	5,160	8,651	3,152	3,600	3,674	3,748
R2706 Project M	2,703	2,078						
R2711 Superconducting DC Homopolar Motor	1,927	2,738						
R2826 Ship Service Fuel Cell		2,933						
R2828 Advanced Water Jet AWJ-21	3,372							
R2831 High Temperature Superconducting AC Synchronous Navy Propulsion Motor & Generator	3,862	4,890						
R2848 Hybrid Small Waterplane Area Catamaran (HYSWAC)	7,015							
R9013 Littoral Surface Craft – Experimental	15,549							
R9014 Curved Plate Technology	2,412							
R9015 Deployable SMARTLINK Communications Upgrade	1,445	1,467						
R9016 Real Time Fire and Smoke Prediction Tool	963							
R9017 Wireless Sensors for Total Ship Monitoring	2,697							
R9018 Knowledge Projection for Fleet Maintenance	2,410							
R9019 Wave Powered Electric Power Generating System for Remote Naval Sites	1,930	1,956						
R9120 High Speed Cargo Craft		734						
R9138 Center for Maritime Systems								

			1,368					
R9139	Graphite Fiber Sandwich Composites for Advanced Warship Design							
			977					
R9140	High Speed Permanent Magnet Generator							
			3,423					
R9141	Marine Direct Ship Service Fuel Cell Technology Validation Trainer							
			1,187					
R9142	Smart Micro-sensor Arrays for Shipboard Damage Control							
			5,169					
R9143	Smart Sensor Web							
			1,027					
Total	134,154	86,270	55,780	82,554	56,289	57,842	63,209	64,043

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, Electric Warship, Total Ownership Cost and Missile Defense Future Naval Capabilities (FNCs).

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

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603123N
PROGRAM ELEMENT TITLE: Force Protection Advanced Technology

B. ACCOMPLISHMENTS/PLANNED PROGRAM: PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	139,782	57,604	51,773	56,487
Adjustments from FY 2003 President's Budget:				
Congressional Plus-Ups		30,625		
High Speed Cargo Craft (realigned from 0708730N)	4,000			
SBIR Reduction	-2,115			
Execution Adjustments	-6,386			
Congressional Rescissions/Adjustments/Undistributed Reductions	-1,127	-1,022		
S&T Program Adjustments			5,748	28,198
NWCF Rate Adjustments			-147	-14
Efficiencies at NWCF Activities			-305	-338
Pay Raise/Inflation Adjustments		-937	-1,289	-1,779
FY 2004/2005 President's Budget Submission:	134,154	86,270	55,780	82,554

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

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: Force Protection Advanced Technology

Project Number: R2912
Project Title: Force Protection Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2912 Force Protection Advanced Technology	87,869	49,808	50,620	73,903	53,137	54,242	59,535	60,295

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 02	FY 03	FY 04	FY 05
Surface Ship & Submarine Hull Mechanical & Electrical (HM&E)	36,001	34,237	29,582	57,323

Activity includes: Signature reduction, hull life assurance, distributed intelligence for automated survivability and advanced electric warship 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. Electric warship 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.

FY 2002 ACCOMPLISHMENTS:

- Signature Reduction:

Initiated:

- Surface ship boundary element model development for application to near field de-amping.
- Adaptation and validation of an existing physical model of surface ship for near field de-amping demonstration.

- Stable algorithm development of near field de-amping system.

Continued:

- Large-scale truss element evaluation for Advanced Machinery Support System (AMSS).

Completed:

- AMSS condenser overboard discharge acoustic silencing demonstration.

- Hull Life Assurance:

Initiated:

- Ship test planning for passive ship protection. (Transitions to Project R3049 PE 0603123N in FY03)

Completed:

- Propellant characterization and thermochemical combustion model for passive ship protection.
- Tools for predicting the total response of stowed ordnance in a ship with and without protective elements of Anti-Fratricide Shielding and Explosive Load Reduction.
- Contracted to develop design for High Speed Cargo Craft.

- Distributed Intelligence for Automated Survivability:

Initiated:

- Advanced Damage Countermeasures - investigation of watermist firefighting application for electronic spaces. (Transitions to Project R3049 PE 0603123N in FY03)
- Development of an advanced volume sensor for fire and smoke detection. Data collection and field test of volume sensor. (Transitions to Project R3049 PE 0603123N in FY03)

- Electric Warship:

Initiated:

- Ground Combat Vehicle Testbed program by using DARPA Reconnaissance, Surveillance, Targeting Vehicle (RSTV).
- Development of advanced power electronics for Electromagnetic Aircraft Launch System (EMALS) and ship main propulsion.

Continued:

- Ship Service Fuel Cell Demonstration (625kW) including diesel fuel reforming technology for molten carbonate and proton exchange membrane (PEM) fuel cells.
- Quiet Electric Drive/Submarine Secondary Propulsion Unit (SPU).

Completed:

- Aircraft Electrical Servicing Station (AESS) Demonstration

FY 2003 PLANS:

- Signature Reduction

Continue:

- Large-scale truss development for Advanced Machinery Support system (AMSS).

Complete:

- Surface ship near field de-amping boundary element and physical model development (includes stable algorithm).

- Electric Warship:

Initiate:

- Development of design for advanced main propulsion superconducting motor.

Continue:

- Development of advanced power electronics for Electromagnetic Aircraft Launch System (EMALS) and ship main propulsion systems.
- Quiet Electric Drive development of secondary propulsion unit (SPU).
- Ship Service Fuel Cell Demonstration (625kW) including diesel fuel reforming technology for molten carbonate and proton exchange membrane (PEM) fuel cells.

Complete:

- Proving ground testing of RSTV vehicle.
- Development of design for advanced main propulsion superconducting motor.

FY 2004 PLANS:

- Signature Reduction:

Continue:

- Large-scale truss development for Advanced Machinery Support system (AMSS).

- Electric Warship:

Initiate:

- Development of technologies for future hybrid electric Marine Corps combat vehicle.
- Advanced main propulsion motor development program.
- Development of advanced fuel cell reformer technology.
- Development of electromagnetic gun technology, including focus on rail wear issues, energy storage, and pulsed power switching.

Continue:

- Quiet Electric Drive/Submarine secondary propulsion unit (SPU).
- Development of advanced power electronics for Electromagnetic Aircraft Launch System (EMALS) and ship main propulsion systems.

- Laboratory evaluation portion of 625kW molten carbonate fuel cell and reformer technology program.

Complete:

- Fabrication of 625kW PEM diesel fuel reformer.

FY 2005 PLANS:

- Signature Reduction:

Complete:

- Large-scale truss evaluation for Advanced Machinery Support System (AMSS)

- Electric Warship:

Initiate:

- Development of advanced energy storage technology.

Continue:

- Development of technologies for future Marine Corps combat vehicle.
- Development of advanced fuel cell reformer technology.
- Advanced main propulsion motor development program and development of advanced power electronics for main propulsion motor drive.
- Development of electromagnetic gun technology, including focus on rail wear issues, energy storage, and pulsed power switching.

Complete:

- Development of advanced power electronics for EMALS and main propulsion systems.
- Quiet Electric Drive/Submarine secondary propulsion unit (SPU).
- Laboratory evaluation of 625kW molten carbonate fuel cell and reformer.

	FY 02	FY 03	FY 04	FY 05
Advanced Energetics	--	--	3,663	--

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, and ultimately to transition advanced technology to the Fleet. 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 2002 ACCOMPLISHMENTS: Described in PE 0602123N

FY 2003 PLANS: Described in PE 0602123N

FY 2004 PLANS:

- Thermobaric Weapon ACTD:

Completed:

- 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 02	FY 03	FY 04	FY 05
Sensors & Associated (S&A) Processing	5,150	4,866	4,310	4,512

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 these platforms with effective self-protection. The technology areas specific to platform protection will develop individual or multispectral [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 multispectral detection and distribution of specific threat information.

FY 2002 ACCOMPLISHMENTS:

For Surface Ships:

Initiated

- The Navy launched a technology program (FY02 through FY06) for a ship-based Distributive Aperture System (DAS), Infrared Search and Track (IRST) for transition to DDX, CGX, and CVNX. The IRST system will enable a passive self-protection capability for U.S surface ships. The system will address the need for low radar cross-section sensor for surface naval ships. The system will provide 360-degree staring panoramic view and awareness at-sea and in port of the surface, air, and asymmetric target set. Each module of the staring system will consist of focal plane arrays, anamorphic optics, stabilization, and modularization techniques. The ship's combat center will control the DAS through a central computer high-speed processor. The DAS, consisting of eight modules for surface combatant ships will vary based on the size of ship. It will provide surface ships with a 360-degree panoramic staring view on the horizon to line of sight, and be able to detect, declare, and track air contacts and surface contacts within 2-3 seconds. The sensor modules will also be able to pan its view downward to view the surface from the ship to line of sight for

in port counter-terrorism awareness. DAS will address the surface naval ship's needs for a passive fighting and in-port security ability. The Navy will demonstrate a three-module prototype with a high-speed central computer in FY06. It is critical to demonstrate the technique to seam stitch three sensors panoramic view.

- The Shipboard electro-optic (EO)/IR closed loop Self Protection effort. Develops and demonstrates an integrated threat detection and closed-loop laser jamming system to counter EO/IR/laser guided threats to Naval combatants. Began integration of hardware for both the closed loop Infrared Countermeasures (IRCM) and open loop Electro-optic Countermeasures (EOCM) laboratory testing. The system will ultimately be demonstrated to be effective against video guided, laser designated, mid-wave IR and long-wave IR guided (both autonomous and man-in-the-loop) seekers from a land site over water.

For Naval Aircraft:

Initiated:

- The Missile Warning System (MWS) and EO/IR Laser Jammer effort will perform technology demonstrations of missile warning system components that are effective in detecting and locating threat missiles with the fidelity required for current and future tactical aircraft. A key component of the system is the development of a two color sensor using a solid state mercury cadmium telluride (MCT) focal plane array (FPA) that will demonstrate a 99% focal plane array operability with an increase in operating temperature from 90° Kelvin to 140° Kelvin and a 100% improvement in the FPA cryogenic cooling efficiency. The FPA was designed and constructed in preparation for laboratory testing along with the high efficiency cooler system.

For Small Platforms:

Initiated:

- Work on the EO/IR self-protection for Small Surface Vehicles is focusing on breadboard demonstration of optical waveguide assemblies and suitable missile warning receivers to provide an automatic response for small platform and local area protection against IR guided and laser designated missiles and munitions. This work is continued within the Electronic Warfare Integrated System for Small Platforms (EWISSP) effort in PE 0603235N in FY03.

For Marine Corps:

Initiated:

- The End User Terminal (EUT) took delivery of and demonstrated the "ruggidized" 6-inch Organic Light Emitting Diode (OLED) display.

FY 2003 PLANS:

For Surface Ships:

Continue:

- Development and packaging of prototype sensor module for IRST Program.

- The Shipboard EO/IR closed loop self-protection effort, designed to increase platform survivability by the detection, classification and jamming of EO/IR/Laser guided threats, will conduct a functional demonstration of its mid-wave IR laser; receive and evaluate a Deuterium Fluoride pulsed chemical laser; and prepare for closed loop IRCM system demonstration in FY04.

For Naval Aircraft:

Continue:

- The Missile Warning System (MWS) and EO/IR Laser Jammer will conduct laboratory common jam code demonstrations and pointer/tracker functional demonstrations. Missile signature data will be collected during live fire tests of opportunity. This live fire data is coupled with recorded urban signature clutter to determine statistically significant system performance improvements such as probability of declaration and false alarm rates. This data is used by the MWS to correctly identify the threat, determine the time-to-go accuracy necessary to track and engage the threat seeker with an Infrared Countermeasures (IRCM) system using common jam codes to cause the seeker to breaklock.

For Marine Corps:

Continue:

- The End User Terminal continued demonstration of the "ruggidized" 6-inch OLED display and proceeded with the design of an integrated antenna for the Dismounted Digital Automated Computing Terminal (D-DACT).

FY 2004 PLANS:

For Naval Aircraft:

Initiate:

- The Integrated Defensive Electronic Counter Measures (IDECM) 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.

For Surface Ships:

Continue:

- Efforts are focused on design, development and testing of systems, subsystems, and components for integration of Distributive Aperture Systems (DAS) sensor modules and components into a DAS capability demonstration model.
- Shipboard Electro-optic (EO)/Infrared (IR) Closed Loop Self Protection effort will complete fabrication of the stabilized optical pointer tracker and conduct testing at the Naval Research Laboratory's Chesapeake Bay Detachment open-air test range.
- Development and packaging of prototype sensor module for IRST Program.

For Marine Corps:

Continue:

- The EUT will proceed by demonstrating fusing imagery and rifle fire detection.

For Naval Aircraft:

Complete:

- The Missile Warning System (MWS) will conduct testing to demonstrate a 75% increase in the minimum detection and declaration range for man portable infrared-guided surface-to-air missiles.

FY 2005 PLANS:

For Surface Ships:

Continue:

- Continue systems and component level development, integration, and testing supporting future Distributive Aperture Systems (DAS) capability demonstration.
- Continue the Shipboard Electro-optic (EO)/Infrared (IR) Closed Loop Self Protection effort demonstrating the compact, high power midwave IR laser at the Naval Research Laboratory's Chesapeake Bay Detachment open-air test range.
- Development and packaging of prototype sensor module for IRST Program.

For Naval Aircraft:

Continue:

- The IDECM effort will perform full-length acceptance testing on the new high temperature towline.
- The EO/IR Laser Jammer for Tactical Aircraft (TACAIR) will demonstrate the targeting Forward Looking IR (FLIR) function with the IRCM tracker.

For Marine Corps:

Continue:

- The EUT effort will integrate the enhanced Radio Frequency (RF) transmitter module with the wearable vest.

	FY 02	FY 03	FY 04	FY 05
Missile Defense (MD)	20,038	6,812	4,815	4,920

The Missile Defense Future Naval Capability (FNC) is intended to develop Littoral Theater Air and Missile Defense (TAMD) technology enhancements for transition to acquisition programs, which will interact efficiently, effectively, and in time to detect, control, and engage projected anti-ship cruise missiles, overland cruise missiles, aircraft and theater ballistic threats. The Missile Defense S&T efforts directly provide elements of the capability required by the Joint Requirements Oversight Council (JROC) Theater Air and Missile Defense (TAMD) Capstone Requirements Document (CRD) (2001). This PE includes those MD FNC elements that perform risk reduction for Force Protection Capability.

FY 2002 ACCOMPLISHMENTS:

- Missile Defense:

Initiated:

The Affordable Ground Based Radar (AGBR) effort initiated design and development of a sub-scale radar for surveillance, air control, and fire control system. It is to be mounted on a High Mobility Multi-Purpose

Wheeled Vehicle (HMMWV). The system will serve as risk reduction for the Multi-Role Radar System (MRRS). Continued in PE0603271N in FY03 and beyond.

- Littoral Affordability (classified program).
- The Advanced Area Defense Interceptor (AADI) effort initiated planning efforts for a Navy/Marine Corps air-directed, surface-to-air missile (ADSAM) live firing demonstration in FY 2007. Effort will coordinate with numerous Navy program sponsors and offices to formalize requirements, establish funding strategy, and prepare demonstration.
- Initiated design of a mass-focused Reactive Material Enhanced Warhead (RMEW), and test planning and Fragment Mat (FRAGMAT) warhead characterization tests.

• Total Ownership Costs:
Continued:

- Development and flight demonstration of Vectoring Extremely Short Take Off and Landing (ESTOL) Control Tailless Operation Research (VECTOR) air platform.

FY 2003 PLANS:

• Missile Defense:
Continue:

- The Reactive Warhead effort will continue in its development of a RMEW for STANDARD Missile, completing Phase I FRAGMAT tests to develop a physics-based damage prediction model and initiating effectiveness analyses of a mass-focused RMEW against Anti-Air Warfare (AAW) targets.
- Littoral Affordability (classified program).
- The AADI effort will continue with planning and coordination for a Navy - Marine Corps ADSAM live firing demonstration in FY 2007.

• Total Ownership Costs:
Complete:

- Development and flight demonstration of VECTOR air platform.

FY 2004 PLANS:

• Missile Defense:
Continue:

- Littoral Affordability (classified program)
- The AADI effort will continue with planning and coordination for a Navy - Marine Corps ADSAM live firing demonstration in FY 2007.

Complete:

- The Reactive Warhead effort will complete advanced design/development efforts for a reactive material warhead for STANDARD Missile, completing Phase II FRAGMAT tests to finalize the physics-based damage prediction model and complete effectiveness analyses of a mass-focused RMEW, and incorporate results into RMEW design.

FY 2005 PLANS:

- Missile Defense:

Initiate:

- The Distributed Weapons Coordination (DWC) effort will initiate advanced combat system integration of complex algorithms for Common Threat Evaluation (CTE), and Preferred Shooter Recommendation (PSR), developed under PE 0602123N, into a real-time open architecture distributed computing environment in preparation for transition to Naval Open Architecture combat systems.

Continue:

- The AADI effort will continue with detailed planning and coordination for a Navy - Marine Corps ADSAM live firing demonstration in FY 2007. This will include analysis and performance evaluation of advanced systems in an ADSAM environment.

Complete:

- Littoral Affordability (classified program).

	FY 02	FY 03	FY 04	FY 05
Underwater (UW) Platform Self Defense	6,680	3,893	3,250	7,148

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, high speed torpedoes, 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, allow automatic employment, and require no organizational maintenance. Specific technology includes two programs. 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 improved passive shipboard detection, classification, and localization (DCL) of incoming torpedoes and an ATT to engage the threat torpedoes.

FY 2002 ACCOMPLISHMENTS:

Continued:

- Development of ATT and Tripwire Technology Demonstration System (TDS) technology.
- Classified program.

FY 2003 PLANS:

Continue:

- Development of ATT and Tripwire TDS technology.
- Classified program.

FY 2004 PLANS:

Initiate:

- Transition of counter-torpedo technologies to Naval Sea Systems Command (NAVSEA) Tripwire Torpedo Defense System (AN/WSQ-11).

Continue:

- Development of ATT and Tripwire TDS technology.
- Classified program.

FY 2005 PLANS:

Initiate:

- Demonstration of guidance and control to increase effectiveness of ATT in shallow wake environments.
- Demonstration of full-duplex capability for NGCM with towed array fixture.

Continue:

- Development of ATT and Tripwire TDS technology.
- Classified program.
- Transition of counter-torpedo technologies to Naval Sea Systems Command (NAVSEA) (Tripwire Torpedo Defense System (AN/WSQ-11).

	FY 02	FY 03	FY 04	FY 05
Littoral Surface Craft – Experimental (LSC(X))	20,000	*	5,000	0

* FY03: $8,935 funded in PE 0603114N, Project R9013 for LSC(X).

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 no more than 1100 tons at full load. Performance requirements are 50 knots at combat load, 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 2002 ACCOMPLISHMENTS:

Initiated:

- Development of technologies for small, fast craft in the 500-1000 ton range. These technologies enable a craft for missions such as littoral ASW and mine countermeasures.
- Contract level design and construction of the LSC(X) prototype craft.
- Design and development of lifting body and drag reduction system.
- Hullform selection, concept design.

FY 2003 PLANS:

Described in PE 0603114N, Project R9013.

FY 2004 PLANS:

Completed:

- Development of technologies for small, fast craft in the 500-1000 ton range. These technologies enable a craft for missions such as littoral ASW and mine countermeasures.
- Contract level design and construction of the LSC(X) prototype craft.
- Design and development of lifting body and drag reduction system.
- Hullform selection, concept design.

FY 2005 PLANS: Not Applicable

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 System Computers & Intelligence)
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 (Marine Corps 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 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603123N PROJECT NUMBER: R3049
PROGRAM ELEMENT TITLE: Force Protection Advanced Technology PROJECT TITLE: Emerging Threats

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUALS	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R3049 Emerging Threats	0	6,515	5,160	8,651	3,152	3,600	3,674	3,748

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, including the management of weapons effects to control structural damage and the improvement of structural materials. Distributed intelligence for automated survivability addressees both the basic technology of automating damage control systems as well as distributed auxiliary control with self-healing capability.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Emerging Threats	0	6,515	5,160	8,651

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. Distributed control for automated survivability addressees the basic technology of automating damage control systems.

FY 2002 ACCOMPLISHMENTS: Efforts funded and discussed in this PE Project R2912.

FY 2003 PLANS:

- Hull Life Assurance:

Initiate:

- Passive ship protection system design.
- Blast yield/propagation test for passive protection.

Complete:

- Ship test planning for passive ship protection full-scale test.
- Passive ship protection system design.
- Blast yield/propagation test for passive protection.

- Distributed Intelligence for Automated Survivability:

Initiate:

- Development of optical sensor prototype for volume sensor (fire & smoke detection) application.

Continue:

- Small scale testing of high efficiency watermist system for application to electronic spaces within advanced damage countermeasures program.
- Data collection and field test of optical sensor prototype for volume sensor.

FY 2004 PLANS:

- Hull Life Assurance:

Initiate and complete:

- Passive ship protection system test execution.

- Distributed Intelligence for Automated Survivability:

Continue:

- Full scale testing of high efficiency watermist system for application to electronic spaces within advanced damage countermeasures program.
- Real time optical sensor prototype for volume sensor (fire & smoke detection) application.
- Data collection and field test of volume sensor.

FY 2005 PLANS:

- Distributed Intelligence for Automated Survivability:

Complete:

- Full scale testing of high efficiency watermist system for application to electronic spaces within advanced damage countermeasures program.
- Real time optical sensor prototype for volume sensor (fire & smoke detection) application.
- Data collection and field test of volume sensor.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY 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 02	FY 03
Project M	2,703	2,078

Demonstrate 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.

R2711	FY 02	FY 03
Superconducting DC Homopolar Motor	1,927	2,738

Advanced technology supporting preliminary design and construction of a 3.7 MW subscale 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.

R2826	FY 02	FY 03
Ship Service Fuel Cell	0	2,933

Develop and conduct land-based testing of a 625KW molten carbonate marine fuel cell power system capable of running on logistic fuel. This system should be capable of achieving a 50% specific fuel efficiency. Detailed design has been completed and the unit is currently being assembled. Testing will be conducted at the manufacturer’s facility and a Navy laboratory early in FY04.

R2828	FY 02	FY 03
Advanced Waterjet-21 (AWJ-21)	3,372	0

Tested a 1/4 scale unit of the advanced waterjet and subsequent technology demonstration on a scaled platform. Performance of the scaled unit was established and the results were extrapolated to establish the anticipated performance of a full scale pump. A focus of the evaluation was cavitation performance and its impact on propulsive efficiency and acoustic performance characteristics. The propulsive efficiency and signature characteristics of the advanced design were evaluated and established.

R2831	FY 02	FY 03
High Temperature Superconducting AC Synchronous Navy Propulsion Motor & Generator	3,862	4,890

FY02 effort provided design tradeoffs and final design selection for an HTS high power density propulsion motor. Tradeoff and final 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. FY03 begins construction of the HTS propulsion motor and power electronics.

R2848	FY 02	FY 03
Hybrid Small Waterplane Area Catamaran (HYSWAC)	7,015	0

The effort supported modification of the SES platform to a HYSWAC configuration. This modification entails removing the air lift fans and flexible skirts, and adding SLICE-styled pods to partially lift the vessel out of the water with SLICE-like pods. Redesign, conversion and testing of the SES vessel to the new Support at-sea testing for evaluation of the HYSWAC concept.

R9013	FY 02	FY 03
Littoral Suface Craft-Experimental (LSC-X)	15,549	*

(Appropriated in FY03 in PE 0603114N, Project R9013,$8,935)

Design and construction for a Littoral Surface Craft - Experimental (LSC(X)) (now referred to as X-craft), envisioned as a small, fast, experimental ship designed to operate in the littorals. The ship, designed to carry a variety of mission modules, will serve as a testbed for new technologies and new operational concepts. Effort has included development of technologies design and development of lifting body and drag reduction system. Such technologies are suitable for small, fast craft to enable a craft for missions such as littoral ASW and mine countermeasures.

R9014	FY 02	FY 03
Curved Plate Technology	2,412	0

Effort addressed the 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 addressed welding technology for stainless steel that is different from conventional carbon steel approaches. The demonstration built full-scale hull sections that may be used for air-blast and underwater explosion resistance testing.

R9015	FY 02	FY 03
Deployable SMARTLINK Communications Upgrade	1,445	1,467

The effort provides advanced technology application to a Smart Link System. The prototype communication system has been demonstrated to provide an order of magnitude improvement in bandwidth for our sailors at sea. The system uses a revolutionary Flat Parabolic Surface (FLAPS) antenna system, which can transmit 12 phonecalls simultaneously (at a cost of about 10 cents per minute) and can provide video teleconferencing capability. The system is deployable, allowing it to occupy non-dedicated space, be quickly taken down and deployed elsewhere if necessary. The effort of FY02 and the planned effort for FY03 is to provide improved primary communication capabilities during operational deployment.

R9016	FY 02	FY 03
Real Time Fire and Smoke Prediction Tool	963	0

Effort focused on development of advanced technology to better model fire and smoke spread in a shipboard environment. Fire and Smoke Spread Prediction tool was developed to allow effective real time shipboard decision-making and damage control response. Prior modeling capabilities have not supported real time predictions. Verification will be performed on the ex-USS Shadwell via full scale testing.

R9017	FY 02	FY 03
Wireless Sensors for Total Ship Monitoring	2,697	0

Wireless sensor technology for monitoring all shipboard systems and providing situational awareness was addressed. These shipboard wireless sensor networks will enable reduced crewing concepts, collect, integrate and process machinery, combat systems and biomedical information enhancing situational awareness over equipment and personnel. This enhanced situational awareness offers more rapid response to changes in shipboard status. This effort has provided improvement in sensors, computers and software used to process, transmit, display, warn and remedy potentially fatal situations.

R9018	FY 02	FY 03
Knowledge Projection for Fleet Maintenance	2,410	0

Provide advanced technology for better management of fleet maintenance. Effort has developed a new system that will enable collection, processing, transmission and expert analysis of shipboard (Fleet) equipment health and

usage information. Concept will permit off-ship technical experts to assist ship's crew in ship system maintenance and repair.

R9019	FY 02	FY 03
Wave Powered Electric Power Generating System for Remote Naval Sites	1,930	1,956

Provide advanced technology support for the development of a power generating system driven by ocean wave motion. The FY02 effort provided testing, extended the hydrodynamic modeling of a buoy system and validated those models. FY03 effort will address environmental issues, means to improve reliability, increase energy efficiency. The issues associated with operation of a multi-buoy system will also be addressed.

R9120	FY 02	FY 03
High Speed Cargo Craft	*	734**

(*$3,852 Contained in Project R2912 in this PE in FY02)

(**FY03 Funds originally appropriated in PR 0708730N)

Construct and test a small prototype High Speed Cargo Craft. The prototype craft would demonstrate an advanced hull form incorporating a combination of catamaran and surface effect technologies with goal of evaluating the craft’s suitability as a high-speed cargo craft.

R9026	FY 02	FY 03
DDG-51 Composite Twisted Rudder Reconfigurable Ships	*	0

*$965 (Appropriated in FY02 in PE 0603508N)

Effort matures the process technology to fabricate a composite twisted rudder for transition to the DDG-51 and other Navy ships. Goal is to improve quality and solve excessive corrosion problems.

R9138	FY 02	FY 03
Center for Maritime Systems	0	1,368

Develop a rapidly implemented and integrated system of observing networks and forecasting models to provide real-time information on oceanographic and atmospheric conditions affecting Navy sensors and operations. Provide real time data/model uncertainty analysis and a display suitable for decision making. Provide high resolution surveillance of ship traffic oceanic and atmospheric conditions within a specified geographic region. Provide means of rapidly addressing security concerns at USN ship berths at any location in the world.

R9139	FY 02	FY 03
Graphite Fiber Sandwich Composites for Advanced Warship Design	0	977

Investigate the use of carbon sandwich materials for surface ship hull structure. Combine analytical and experimental investigations to address design, survivability and fatigue issues associated with the implementation of these materials for future Navy platforms.

R9140	FY 02	FY 03
High Speed Permanent Magnet Generator	0	3,423

The development of a high speed permanent magnet generator will be initiated with evaluation of heat removal techniques and the preliminary design of the generator. Generator design issues will be addressed to establish the best approach for the electromagnetic and mechanical design, including thermal design issues. Effort will provide assessment of machines potential efficiency and other performance characteristics.

R9141	FY 02	FY 03
Marine Direct Ship Service Fuel Cell Technology Validation Trainer	*	1,187

(*$1,933 Previously designated Project R2826 in FY02 PE 0603508N, Ship Service Fuel Cell Technology Verification & Training Program)

Complete installation of a land-based fuel cell to enable collection of operational data for use in supporting the modeling of system reliability and maintenance. Upon completion of this effort, the system could be made available to be used as a trainer.

R9142	FY 02	FY 03
Smart Microsensor Arrays for Shipboard Damage Control	0	5,169

Development of a high temperature cermet (ceramic-metallic) prototype smart microsensor array system for Navy damage control applications. The chemical microsensor array system offers 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 will be networked using E-Smart (Environmental Systems Management, Analysis and Reporting network) system. Developing flexible readout circuitry using standard Si and then SOI microelectronics will offer high operating temperature control and logic circuitry applicable to shipboard damage control environments.

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Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603123N Project Number: Various
PROGRAM ELEMENT TITLE: Force Protection Advanced Technology Project Title: Congressional Plus-ups

R9143	FY 02	FY 03
Smart Sensor Web	0	1,027

Develop a network of smart, ground based sensors that can operate in an urban environment. The sensors will communicate via power lines or in a wireless mode in the absence of power lines. This technology will be applicable to a variety of operational environments including chemical and biological warfare. It is also applicable to Military Operations Other Than Warfare (MOOTW).

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Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2919 Common Picture Advanced Technology	49,888	36,895	69,194	73,620	62,792	60,262	56,418	57,491
R9020 National Cargo Tracking Program	1,633							
R9145 Command Center Visualization		6,846						
R9146 Improved Shipboard Combat Information Center		3,521						
Total	51,521	47,262	69,194	73,620	62,792	60,262	56,418	57,491

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) includes funds for the advanced technology development, test and evaluation of a dynamic distributed common picture based on leading edge technologies that will improve situational awareness across Command echelons from the Combatant Commander to tactical units afloat and warfighters ashore. The goal is to mature 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. This program will demonstrate the ability to build and maintain a common operational and tactical picture that provides Naval Forces the capability to self-synchronize, increase speed of command, and optimize resource allocations. 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). Advanced technologies to be developed, tested and demonstrated include: (1) multi-media information integration, correlation, archiving and tools for knowledge extraction; (2) multi-source integration (MSI) for composite combat identification (CID) and target tracking; (3)cross-ASW platform acoustic data collaboration, sharing and correlation; (4) development of tools to certify systems for dependability and Information Assurance (IA) properties; (5) small platform situational awareness and protection development of composite routing techniques for integrating real-time and near real-time networks; (6)information networks for cooperative target tracking; (7) efforts to find alternative timing and positioning products to reduce the risk of enemy jamming of the Global Positioning System (GPS); and (8) efforts to integrate undersea environmental and marine mammal information into tactical decisions aids and into the common operational picture. Within the Naval Transformation Roadmap, this investment will technically enable and demonstrate

the "Persistent Intelligence, Surveillance, and Reconnaissance," "Time Sensitive Strike," "Sea Based Information Operations," and "Ship-to-Objective Maneuver" capabilities required by "Sea Strike".

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

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	49,807	37,753	44,022	63,556
Adjustments from FY 2003 President's Budget:				
Congressional Plus-Ups		10,600		
SBIR Reduction	-1,091			
Execution Adjustments	3,047			
Cong Rescissions/Adjustments/Undistributed Reductions	-242	-579		
S&T Program Adjustments			2,836	865
NWCF Rate Adjustments			-208	-10
Efficiencies at NWCF Activities			-182	-204
Pay Raise/Inflation Adjustments		-512	-1,274	-1,587
USCG Vessel Tracking			10,000	11,000
Joint Program Office Special Technology Countermeasures			14,000	
FY 2004/2005 President's Budget Submission:	51,521	47,262	69,194	73,620

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N Project Number: R2919
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology Project Title: Common Picture Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2919 Common Picture Advanced Technology	49,888	36,895	69,194	73,620	62,792	60,262	56,418	57,491

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project includes funds for the advanced technology development, test and evaluation of a dynamic distributed common picture based on leading edge technologies that will improve situational awareness across Command echelons from the Combatant Commander to tactical units afloat and warfighters ashore. The goal is to mature 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. This project will demonstrate the ability to build and maintain a common operational and tactical picture that provides Naval Forces the capability to self-synchronize, increase speed of command, and optimize resource allocations. 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). Advanced technologies to be developed, tested and demonstrated include: (1) multi-media information integration, correlation, archiving and tools for knowledge extraction; (2) multi-source integration (MSI) for composite combat identification (CID) and target tracking; (3)cross-ASW platform acoustic data collaboration, sharing and correlation; (4) development of tools to certify systems for dependability and Information Assurance (IA) properties; (5) small platform situational awareness and protection development of composite routing techniques for integrating real-time and near real-time networks; (6)information networks for cooperative target tracking; (7) efforts to find alternative timing and positioning products to reduce the risk of enemy jamming of the Global Positioning System (GPS); and (8) efforts to integrate undersea environmental and marine mammal information into tactical decisions aids and into the common operational picture. Within the Naval Transformation Roadmap, this investment will technically enable and demonstrate the "Persistent Intelligence, Surveillance, and Reconnaissance," "Time Sensitive Strike," "Sea Based Information Operations," and "Ship-to-Objective Maneuver" capabilities required by "Sea Strike".

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N Project Number: R2919
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology Project Title: Common Picture Advanced Technology

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Knowledge Superiority and Assurance (KSA)	14,650	16,197	24,713	40,161

KNOWLEDGE SUPERIORITY AND ASSURANCE (KSA): The objective of KSA Future Naval Capability (FNC) is to create and deliver underpinning technologies that enable Network-Centric Operations, including the FORCEnet concept for Naval warfare. The approach involves technology developments in the areas of a) common consistent knowledge, b) dynamically managed, interoperable, high-capacity connectivity, and c) time-sensitive decision-making. Common consistent knowledge meets operating force requirements for common picture information in planning, monitoring and replanning. Dynamically managed interoperable high-capacity connectivity addresses wireless and Quality of Service (QOS) network technology. Time sensitive decision-making supports tactical operations where timeliness and accuracy in decisions is crucial. The pay-off will be knowledge-based threat assessment and rapid response for emergent, time-critical events. The goal of this activity is to support greater speed of command and increased combat power with a reduced workforce.

FY 2002 ACCOMPLISHMENTS:
Developed software and demonstrated the Integrated Decision Support System Product Suite in a laboratory setting, which reduced time critical strike pre-mission planning time by enabling rapid access to relevant information sources, course-of-action analysis, and vulnerability assessments through the use of autonomous software agents. Developed a Link 16 dynamic network management tool and a new time-slot allocation protocol that reconfigures the network faster to allow for entry and exit of network participants and achieves a five-fold throughput improvement over the current fielded operational capability by accessing all available time-slots instead of leaving them dedicated to absent network participants. Demonstrated tactical and operational improvements in the exchange of information between U.S. and Allied/Coalition forces using virtual private networks and secure web servers in the Multi-national Virtual Operations Network Effort. The Commander In Chief Twenty-First Century Advanced Concept Technology Demonstration (CINC 21 ACTD) demonstrated distributed, collaborative planning and execution with an effort that increased speed and quality of command decisions by providing visualization, knowledge management, network monitoring, and collaboration tailored to command decision points. The CINC 21 initiative enabled the Combatant Commanders and Joint Task Force staffs to effectively manage multiple crises and theater security coordination using a flexible web-based decision support portal. The Virtual Information Center Technologies for Open Source Requirements effort provided tailored, web-based access to open source data, enabling naval forces to improve situational understanding by retrieving non-traditional information sources relevant to their operations.

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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N Project Number: R2919
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology Project Title: Common Picture Advanced Technology

FY 2003 PLANS:
Enhance the Integrated Decision Support System Product Suite by conducting at sea demonstrations. Continue the Multi-National Virtual Operation Network with at sea demonstrations in early FY 2003 between UK naval platforms and US naval platforms. Continue the Link 16 efforts, refining and testing the time-slot allocation protocol. This activity will also refine the features of the Virtual Information Center Technologies for Open Source Requirements by improving the filters required to retrieve diverse information. Continue development of a Joint Mission Planning System for Expeditionary Forces Surface Assault Planning (Continued from PE 0602235N). Continue to support the CINC 21 ACTD by developing additional demonstrations of distributed collaborative planning and execution tools to support command decisions. Initiate development of necessary software and system certification of secure coalition web servers to share tactical multiple media data products with coalition forces.

FY 2004 PLANS:
Continue the at-sea demonstration of dynamic reconfiguration of Link 16, the CINC 21 ACTD and the Multi-National Virtual Operational Network. Capitalize on the results of several initiatives to develop large scale integrated end-to-end demonstrations focusing on the following priorities: demonstrating increased speed and quality of command decisions by providing visualization, knowledge management, network monitoring, and collaboration tailored to command decision points; enabling dispersed decision-makers to synchronize operations and assess alternative plans through groupware and collaborative work sessions; enabling integration and information sharing across commands through a web-based crisis management tool; and supporting rapid course of action development (faster than real-time) with simulations and models.

FY 2005 PLANS:
Conduct large scale integrated end-to-end capabilities demonstrations of initiatives that focus course of action analysis (such as the Integrated Product Suite), providing cross-force and cross-echelon situational awareness by demonstrating the capability to manage complex, heterogeneous information through advanced information search, retrieval and management techniques and user-tailorable, intuitive, situation-at-a-glance visualization technology, demonstrating 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. These integrated capabilities demonstrations will bring together the technologies developed in previous years for testing in an operational environment to demonstrate improved warfighting support.

	FY 02	FY 03	FY 04	FY 05
Integrated Anti-Submarine Warfare (IASW)	4,600	4,600	0	0

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N Project Number: R2919
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology Project Title: Common Picture Advanced Technology

INTEGRATED ANTI-SUBMARINE WARFARE: Integrated ASW (IASW) supports the Littoral Anti-Submarine Warfare (LASW) FNC. The emphasis is on developing 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 that will be developed and demonstrated 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 ASW. These technologies will provide input to the common tactical and environmental ASW picture, significantly enhancing ASW effectiveness. While advanced information technology has transformed many aspects of warfare, achieving the same transformation to network-centric capabilities in the ASW environment has proven significantly harder to implement 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 ASW network-centric warfare.

FY 2002 ACCOMPLISHMENTS:
IASW extended the technology previously developed for inter-platform fusion between surface combatant ships and Maritime Patrol Aircraft (MPA). Efforts were initiated efforts to fuse inter-and intra-platform data to support the common ASW tactical picture and were supported the effort with data collections and at sea operational tests. Data collections were performed in Ship ASW Readiness Measurement (SHAREM) 141 and 142.

FY 2003 PLANS:
IASW will conclude the development and assessment of the advanced inter-and intra-platform fusion engines, installing the fusion hardware and software, conducting the final sea test, and documenting the results of the assessments and sea tests. In particular, the FY 2003 focus of the effort will be on inter-platform fusion of Distant Thunder data. The final deliverable will be an integrated hardware and software system.

FY 2004 PLANS: Not applicable.

FY 2005 PLANS: Not applicable.

	FY 02	FY 03	FY 04	FY 05
Multi-Source Integration (MSI) and Combat Identification (CID)	7,500	3,300	4,006	7,125

MULTI-SOURCE INTEGRATION (MSI) AND COMBAT IDENTIFICATION (CID): The emphasis of this Missile Defense FNC activity is to mature and test advanced technologies for Multi-Source Integration (MSI) to improve situational awareness and reduce

operator workload; improve cooperative target tracking; improve Combat Identification (CID) to characterize objects in the battlespace and direct military operations and weapons resources with a high degree of confidence; and to extend Naval capabilities for engaging air targets near point of origin by using all source data to formulate a common operational and tactical picture of the total battle space.

FY 2002 ACCOMPLISHMENTS:
This activity initiated efforts to fabricate an advanced development model of the Affordable Ground Based Radar (AGBR). AGBR technology is planned for insertion into the Marine Corps Multi-Role Radar System (MRRS) for development in the Fiscal Year 2005 time frame. (This effort moved to PE 0603271N in FY 2003.)

Other FY 2002 accomplishments include algorithms for the E-2C aircraft MSI which correlate and fuse multiple off-board satellite communications (SATCOM) data. The Composite Combat ID (CCID) project continued to develop algorithms and computer efforts to fuse and correlate EP-3E Story Maker non-real-time Intelligence, Surveillance and Reconnaissance (ISR) identification information with real-time radio frequency (RF) sensors and Cooperative Engagement Capability (CEC) track data. The CCID project also initiated related efforts to correlate ISR data in Ship Signal Exploitation Equipment (SSEE) with CEC track data and to develop a CID common reasoning algorithm for naval open architecture combat systems.

FY 2003 PLANS:
The initial SATCOM MSI capability transitioned to the E-2C acquisition program in December 2002. The MSI project will continue developing algorithms to integrate RF sensors, Identification Friend or Foe (IFF) data, CEC and Joint Tactical Information Distribution System (JTIDS) data. The CCID effort will continue development of algorithms to correlate and fuse CEC data with ISR data processed aboard EP-3E aircraft and SSEE-equipped surface ships and an advanced CID common reasoning algorithm for the naval open architecture combat system.

FY 2004 PLANS:
The MSI effort will continue developing and testing algorithms to integrate RF Sensors, IFF, and JTIDS to SATCOM Electronic Intelligence data broadcasts. An advanced sensor netting technology (ASNT) project begun in FY 2002 in PE 0602235N will continue development of advanced algorithms for integration of electronic surveillance (ES) data into the CEC program. The CCID effort will complete development of algorithms to correlate and fuse CEC data with ISR data processed aboard EP-3E aircraft and continue development of an advanced common reasoning algorithm for the naval open architecture combat system.

FY 2005 PLANS
The MSI effort will continue algorithm development efforts for the integration of RF Sensors, IFF, and JTIDS to SATCOM Electronic Intelligence data broadcasts in the E-2C aircraft and begin efforts to apply these algorithms to other

platforms, including the naval open architecture combat system. The ASNT effort will continue development of advanced algorithms for integration of ES data into the CEC program. The CCID effort will conduct subsystem integration and systems integration laboratory testing of a common reasoning algorithm, while continuing to develop algorithms to correlate and fuse CEC data processed aboard SSEE-equipped surface ships.

	FY 02	FY 03	FY 04	FY 05
Platform Protection/Electronic Warfare Systems	1,000	3,800	8,477	7,336

PLATFORM PROTECTION/ELECTRONIC WARFARE SYSTEMS: This activity supports the Fleet/Force Protection (FFP) FNC. Current small platforms (both surface and airborne) have little to no Situational Awareness (SA) capability which significantly jeopardizes their battlefield effectiveness and combat survivability. This activity addresses developing the Electronic Warfare Integrated System for Small Platforms (EWISSP), a compact, small platform electronic warfare capability consisting of radio frequency (RF) and electro-optic (EO) and infrared (IR) sensors for platforms such as smaller ships, amphibious assault vehicles, 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 the EWISSP effort addresses several small surface platform self protection system integration requirements and employs monolithic micro/
ave integrated circuit (MMIC) devices and a new antenna to form an extremely compact, low volume/lightweight system that provides very accurate hemispheric direction finding and self-protection capability against threat missile systems.

FY 2002 ACCOMPLISHMENTS:
During Phase I of the four phase EWISSP initiative, the threats to small Navy and Marine combat platforms were defined, individual vehicle integration and installation requirements/limitations were determined, and measurements of the platform signature (RF/MMW/IR) were conducted.

FY 2003 PLANS:
Plans for FY 2003 for the EWISSP initiative include initiating Phase II acceptance testing of the Shipboard Laser Acquisition System (SBLAS). Ninety-degree system testing will be conducted. The various component modules will be fabricated and integrated within the system. Phase I of the EWISSP initiative will conclude in FY 2003.

FY 2004 PLANS:
The EWISSP initiative will continue with Phase II of its development plan. During the three year Phase II effort, plans include continuation of the development, fabrication, integration, test, and demonstration of a low cost highly

integrated Electronic Warfare (EW) system for small vehicles that operate in a littoral environment. Initial emphasis will be on demonstrating the application of advanced technology to increase the survivability of the Marine Advance Amphibious Assault Vehicle (AAAV). EWISSP will be developed as a highly integrated EW system based on an open architecture design to allow rapid technology insertion. Using the results and technology demonstrated during the previous fiscal year efforts, the 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 design, parts procurement, and initial assembly and integration. Subsystems will be designed and fabricated to integrate with the AAAV, but with enough flexibility to integrate with small platforms such as the Landing Craft, Air Cushion (LCAC) and Landing Craft, Utility (LCU) vehicles. 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 AAAV will involve a significant effort due to limited space and power available in the AAAV as well as severe restrictions on modifications to the vehicle's exterior configuration.

FY 2005 PLANS
Phase II will continue with the fabrication, 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. Significant effort will be invested in software integration between subsystems as well as preparing for subsequent system integration and test with component modules assembled into a brass board configuration for laboratory and limited field testing. 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 02	FY 03	FY 04	FY 05
Communication Security	15,000	0	0	0

COMMUNICATION SECURITY: Classified Program

	FY 02	FY 03	FY 04	FY 05
Information Security Research	1,000	1,998	1,998	1,998

INFORMATION SECURITY RESEARCH: The goal of this activity is to ensure the continued protection of Navy and Joint information and information systems — the information infrastructure — from hostile exploitation and attack. Protecting the information infrastructure of joint, coalition, and Naval tactical commands requires situational awareness of

network assets and operations. The rapid rate of change in the underlying commercial and government information infrastructures makes the provision of security an increasingly complex and dynamic problem. Information Assurance (IA) technologies and deployment strategies must evolve quickly to meet the rapidly evolving threats and vulnerabilities. In close cooperation with Office of the Chief of Naval Operations and National Security Agency, this activity focuses on integrating successful proof of concept research prototypes developed under PE 0602235N. The goals are to: improve network resistance to denial of service attacks; improve the Indications and Warnings of suspect activities through tool and process development; conduct traffic analysis; develop network sensors to monitor and assess network status and health; identify new capabilities to analyze and network vulnerabilities and attacks; measure the effectiveness of IA protective measures; and recertify IA software.

FY 2002 ACCOMPLISHMENTS:
Proved the mathematical correctness of the security policy model for the next generation Programmable Embedded Infosec Products (PEIP) and the PEIP kernel that provides secure two-way network communications. Designed a new collaborative software tool for security configuration control and management to facilitate combining assurance evidence needed in software system certification and accreditation. Designed network tools for unobserved monitoring and data collection of intrusive behaviors on networks. Validated a prototype device, known as the Naval Research Laboratory (NRL) Network Pump, for securely transferring data from a lower to a higher level of classification.

FY 2003 PLANS:
Continue to examine the tools and methodologies that will ensure network survivability. Develop and validate 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. Continue the development of the NRL Network Pump.

FY 2004 PLANS:
Continue to develop and validate secure group network protocols within a small enclave, as well as developing 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. Work on the NRL Network Pump will continue, to include developing methodologies to securely transfer data from a high level of classification to a lower level within an enclave.

FY 2005 PLANS:
Continue to develop and validate general scaleable secure group network protocols for multiple trusted coalition partners along with the tools and methodologies to formally 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 develop the NRL Network Pump, focusing on the ability to transfer data securely from high to lower levels of classification across dissimilar networks.

	FY 02	FY 03	FY 04	FY 05
Extending the Littoral Battlespace	1,000	1,000	0	0

EXTENDING THE LITTORAL BATTLESPACE: 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). This activity is designed to bring tactical level network connectivity and data interoperability within a Joint Task Force across all services, with operational deployment following final system tests. This activity will demonstrate enhanced integrated command, control/fires, and targeting capability in support of joint dispersed units, thus enabling common situational awareness, enhanced access to joint fires and facilitating dynamic maneuver while reducing fratricides.

FY 2002 ACCOMPLISHMENTS:
The activity focused on transition of proven technologies to multiple acquisition programs and system tests of the ELB ACTD equipment and application suite in preparation for calendar year (CY) 2004 deployment with Joint Task Force elements including a Navy Carrier Battle Group, Amphibious Readiness Group, Marine Air-Ground Task Force, Army Brigade Combat Team and Air Force Air Operations Center. This activity received Joint Requirements Oversight Council (JROC) approval of change of focus from ELB to JTF WARNET. Other accomplishments include procuring long lead radios, authoring application and database elements, and performing system integration and testing. This activity also supported field demonstrations of selected sensor systems in multiple exercises, including Millennium Challenge 02, and established a Transition Integrated Product Process Team to with integrating products across the DoD.

FY 2003 PLANS:
The JTF WARNET will complete final design and integration of hardware and software network components, perform system level integration and testing and conduct system level training for operational forces. This activity will conduct an end-to-end field demonstration of JTF WARNET components culminating in a pre-deployment exercise, prepare for FY 2004 operational deployment and implement transition agreements to acquisition programs of record.

FY 2004 PLANS: Not applicable.

FY 2005 PLANS: Not applicable.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N Project Number: R2919
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology Project Title: Common Picture Advanced Technology

	FY 02	FY 03	FY 04	FY 05
Global Positioning System (GPS) & Navigation Technology	3,638	5,000	5,000	5,000

GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY: This activity is concerned with the enhancement of GPS capabilities (in the area of anti-jam technology) and the development of several technologies that provide the Navy with alternative navigation methods to the Global Positioning System (GPS). This activity also develops the atomic clock for inclusion in Naval systems. 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. The atomic clock efforts include small, low-cost Rubidium (Rb), Coherent Population Trapping (CPT) atomic clock development, and Precision Rb Maser Atomic Clock. These areas will provide alternatives to GPS navigation and alternatives to the availability of precision, GPS-provided, time transfer. These areas are being pursued to remove the operational risks associated with enemy jamming of GPS functions.

FY 2002 Accomplishments:
Completed the Anti-Jam (AJ) Automatic Integrity Measurement Equipment (AIME) receiver. Completed the Tightly Coupled GPS and INS effort, in which the range measurement circuit of the GPS receiver was tightly coupled to the INS, achieving very high accuracy and compact size. This approach yields more accurate positioning and has the potential for wide Navy/DoD application and low unit cost. The small, low cost Rb CPT Clock development effort continued as an engineering development model (the size of 40 cc). The development model was completed and underwent laboratory testing. Improved digital circuitry was developed in parallel with present analog circuits. The digital approach produces a significant size and power consumption reduction. The Precision Rb Maser Atomic Clock development effort continued in laboratory testing and involved the development of gas holding cells that minimized wall collision effects and improved stability and precision. In a significant developmental breakthrough, the Atom Interferometer Gravity Gradiometer effort miniaturized the entire apparatus from room-size to microwave oven-size, while increasing sensitivity. Initiated the Electro-optic Accelerometer effort. This Miniature Electro-mechanical System (MEMS) was determined to be uniquely sensitive and established a totally new class of devices within MEMS that were not challenged by high, relative frictional losses and attendant sensor/device noise. Initiated the Organic Link-16 Relative Navigation effort, which will define improved positional accuracy and precision time transfer. Completed GPS-Tightly Coupled GPS device at Raytheon Corporation. The high Immunity to jamming and the small physical size of this device make it very a significant enhancement to military navigation. Proposed compact design of a Gravity Gradiometer Device is a very significant accomplishment because it transforms a room-sized device (funded earlier in this effort) to one that is of the order of

a cubic meter. This technological achievement, when completed, will have a wide range of Terrain-Aided Navigation applications, the most important of which concern submarines.
FY 2003 Plans:
Continue work on atomic clock efforts. A field test unit (FTU) of the small, low cost Rb CPT clock will be produced. The Precision Rb Maser Atomic Clock development research continues, providing very useful technical data to design a next generation precision Rb maser clock. Build on this Rb CPT-Atomic Clock effort, and fabricate a 10 cubic centimeter Rb CPT Atomic Clock. This small size, low power consumption, precision clock can have revolutionary effects upon time transfer among military platforms. The final objective of the Atom Interferometer Gravity Gradiometer effort will be concentrated on reducing the size of the optical and electronic (control) units of the gravity gradiometer. The Atom Interferometer Gravity Gradiometer effort will be completed in FY 2003. Work on the Electro-optic Accelerometer effort will focus on refining the monolithic fabrication process and ensuring that the calibration and stability of the device is suited to representative navigation technology applications. The Organic Link-16 Relative Navigation effort will continue to determine what minimal modifications to the link will provide the spatial and temporal precision needed when GPS is denied. The Scalable Multi-Element Space and Time Array Processing (STAP)-based Adaptive Array will be initiated to suppress jamming signals in the receiver. Initiate the Differential GPS Navigation with Link-16 (DGPS) effort to increase positional accuracy and data reliability. The concept of GPS augmentation such as Wide Area Augmentation System (WAAS) will be extended to a tactical situation where the communications link will be Link-16 instead of International Marine Satellite (INMARSAT-3 SATCOM). This will provide a much more accurate positioning system than that of a stand-alone GPS receiver. The new GPS M- code and C/Y- code Application Specific Integrated Circuit (ASIC) development effort will begin to exploit the gain this route provides when jamming is present. Also to be initiated in FY 2003 is an effort designed to speed the acquisition of M-Code. Initiated in FY 2003 were two bathymetric sonar programs, one to sense topological features of the sea floor for Navigation purposes and the other to measure a submarine's relative motion over the seafloor for the purpose of enhancing inertial sensor accuracy.

FY 2004 Plans:
The Organic Link-16 Relative Navigation effort will modify software to correct the precision time transfer, which will be implemented. The work on the Electro-optic Accelerometer will be concerned with utilization of the electro-optical accelerometer in practical Inertial Measurement Unit (IMU) and embedded GPS inertials (EGIs). In FY 2004, the DGPS will be tested in a test range to demonstrate the accuracy of the system. For GPS M-and C/Y-code ASIC, the requirements of the existing C/Y-codes and future M-code will be compared. The investigation will concentrate on the transition period when both codes could be hosted on a single receiver with a minimum disruption for Navy users. Also, a 7-element Space time Adaptive Processing (STAP) dual receiver-antenna will be developed for the Scalable Multi-Element STAP-based Adaptive Array effort. The thrust of the Field Programmable Gate Array (FPGA) GPS software receiver effort will be concerned with the development of a GPS software receiver, which can adapt to “near-far” reception in real time operation by making use of pseudolites. The gravity gradiometer effort, Kasevich-Stamford University, will continue

with calibration and field testing of the new compact design. The 10 cc Rb CPT Atomic Clock will be continued in FY04. The Acoustic Bathymetric Estimator is planned to complete performance trials and efforts to transition the effort to SP24 will be initiated.
FY 2005 Plans:
The Electro-optic Accelerometer effort will be applied to several DOD MEMS IMU efforts such as the Strategic Systems Project Office for submarine platforms. The Differential GPS Navigation with Link-16 effort will be demonstrated in a test bed capable of hosting an integrated navigation system and time refinement system. The GPS M- and C/Y-code ASIC development effort will be simulated and a final ASIC specification will be produced for further development of GPS MYCA ASIC. The Scalable Multi-Element STAP-based Adaptive Array effort will evolve into a 15-element STAP array with dual polarization, which will be developed and tested. The Acoustic Bathymetric Estimator (ABE) will be transitioned in this period. The Ultra-miniature Rb CPT Clock Development effort will provide both the optical and electronic subsystems of the ultra-miniature Rb CPT clock, and will be developed to achieve a size of 10 cc. The Deeply Integrated GPS Receiver with INS effort will provide fielded and future GPS user equipment with improved anti-jam margin for tracking GPS signals in strong interference environments.

	FY 02	FY 03	FY 04	FY 05
Marine Mammals	1,500	1,000	1,000	1,000

MARINE MAMMALS: This activity provides both data and models for making decisions regarding the interaction of Naval activities with protected marine life and habitats (e.g., marine mammals, birds, turtles, fish, fish habitat, etc.). In keeping with Navy environmental stewardship policies laid out in the National Environmental Policy Act (NEPA), Executive Order (E.O) 12114, SECNAVINST 5090.1.b., and related documents, the advanced technologies under this activity ensure Navy compliance with appropriate environmental laws while still maintaining full operational and exercise capabilities. This activity provides hardware and software solutions that are uniquely suited to the marine environment in which the Navy operates and which are uniquely compatible with existing tactical and meteorological and oceanographic assets used by Navy. No other agency or service is capable of providing the unique combination of biological information for a marine environment, placed in the context of other common tactical picture assets unique to the Navy's mission and area of operation.

FY 2002 Accomplishments: The Marine Mammal Monitoring on Navy Instrumented Test Ranges (M3R) initiative demonstrated the ability of Navy instrumented test ranges to self-monitor for protected marine life. It also initially examined problems of marine mammal call detection, multi-hydrophone detection report data association, and multilateration tracking. This effort is fully integrated with related efforts and is providing compatible, integrated monitoring at both the Advanced Undersea Test and Evaluation Command (AUTEC) (Bahamas) and Pacific Missile Range Facility (PMRF) (Kauai) Navy

Instrumented Test Ranges. M3R recorded marine mammal vocalization data on-site at both AUTEC and PMRF with periodic sampling of selected hydrophones and recordings initiated upon detection of call signals. At present, this effort has collected 7-hydrophone and 4-hydrophone acoustic recordings for a period of one year and has successfully tested the system capability for monitoring the full set of array hydrophones. This activity further established a database of marine mammal call data for the ranges, which is being used to develop automated detection algorithms for eventual completely hands-off operation.

This activity also developed and tested a real time unified detection algorithm at PMRF. This algorithm was used successfully to detect a wide variety of marine mammal calls, including broadband clicks and frequency sweeps, along with an algorithm to calculate the Time-Difference of Arrival (TDOA) between hydrophones. In addition, this initiative successfully modified AUTEC 3D hyperbolic multilateration tracking algorithms to accept associated, detected call data from multiple hydrophones. This initiative attached and recovered Woods Hole Oceanographic Institute (WHOI) tags on two pilot whales, provided real time 3-D track of several marine mammal species from a field of over 60 AUTEC sensor arrays, and used them to guide WHOI scientists to marine mammals for tagging and confirmation of species ID and location.

The Marine Mammal Acoustic Safety Criteria effort conducted Temporary Threshold Shift (TTS) measurements to quantify the impact of sounds on marine mammals. This activity completed TTS testing with two California sea lions exposed to single underwater impulses, with hearing thresholds measured at 1 and 10 kHz. This initiative also conducted a series of open water calibration measurements with US Navy shipborne tactical sonars (AN/SQS-53C) as a prelude to potential TTS measurements using the AN/SQS-53C sonar as a sound source. The entire Office of Naval Research (ONR) TTS program was reviewed by an external board of visitors Oct 1-2. The work was found to be of high scientific quality and recommendations of the Board of Visitors (BOV) will be implemented in the FY03 work plan.

FY 2003 PLANS:
M3R will complete automated signal processing algorithm testing. The tested algorithms will enable the automatic collection of marine mammal data during usage of Navy test ranges. It will also provide an integral, non-interfering self-monitoring capability for environmentally compliant test range operations. M3R data will also be ground-tested (calibrated) against visual and other standardized acoustic monitoring assets, to correlate M3R detection data with estimated actual numbers and distributions of marine mammals on the range. These tests will include aerial visual surveys of the AUTEC range in January, ongoing aerial visual surveys at PMRF through April, and a test of whale detection radar and drone aircraft, also at PMRF (radar and drone aircraft projects funded by ONR STTR program). This ability to convert range detection rates to a numerical estimate of total animals present is critical to range environmental compliance documentation under National Environmental Policy Act (NEPA) and Navy regulations.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N Project Number: R2919
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology Project Title: Common Picture Advanced Technology

The Prediction of Acoustic Safety Criteria initiative will prepare and demonstrate a synthesized model of TTS that is able to predict safety thresholds for any Navy sound source operated under any specified set of conditions. The result will be a set of consistent, standardized impact assessment criteria for all Naval activities emitting underwater sound. Based on Oct 2002 BOV review, the TTS program will focus on TTS thresholds for longer exposure durations (2-24 hours) to establish a minimum safe continuous exposure level. They will also investigate recovery rates from TTS to provide Navy with an algorithm for estimating TTS from intermittent sounds like sonar pings.

FY 2004 PLANS:
M3R has received widespread positive attention within Navy and has accelerated validated demonstrations and technology transfer plans. In FY04 and 05 M3R will be expanded to another Navy test range, the SCOR range in southern California, under CNO (NAVSEA) 6.4 funding. In FY05-06 M3R will be evaluated as a monitoring and mitigation asset for the East Coast Shallow Water Training Range (ECSWTR). During this same period M3R capabilities will be assessed for the new Navy range wide tactical theater training assessment planning (TAP) environmental information collection and management plan. With the completion of the unified model of TTS in FY 2003, and its adoption by Navy and other regulatory oversight organizations, FY 2004 efforts will focus on data collection for the purpose of strengthening and expanding the unified model, as needed. Data collection will continue to establish the time/energy tradeoff for long duration exposures and to establish a recovery rate algorithm to estimate TTS growth when the signal is intermittent. Specific TTS testing with 53C sonar signals will be decided by joint Office of Naval Research (ONR)/Chief of Naval Operations (CNO) investment planning in FY03-04.

FY 2005 PLANS:
M3R will have complete demonstration of its value as an operational tool to monitor range environmental management. M3R will demonstrate its ability to run at a non-interfering background level to enable simultaneous self-monitoring for environmental compliance while keeping the range fully operational for tactical missions.

	FY 02	FY 03	FY 04	FY 05
USCG Vessel Tracking	0	0	10,000	11,000

USCG Vessel Tracking: Details are of a higher classification.

	FY 02	FY 03	FY 04	FY 05
Joint Program Office Special Technology Countermeasures	0	0	14,000	0

Joint Program Office for Special Technology Countermeasures: Details are of a higher classification.

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 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

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603235N Project Number: Various
PROGRAM ELEMENT TITLE: Common Picture Advanced Technology Project Title: Congressional Plus-ups

Congressional Plus-Ups:

R9020	FY 02	FY 03
National Cargo Tracking Program	1,633	0

NATIONAL CARGO TRACKING PROGRAM: This effort was authorized and appropriated by Congress to develop the Navy's capability to track containerized cargo in support of Homeland Defense. The funds supported the ability to merge disparate data sources into a central database, allowing for the expeditious analysis of cargo-related data. Work included data warehouse development, integration of advanced analytical tools (software and analytical models) and deployment of analytical tools for cargo tracking.

R9145	FY 02	FY 03
Command Center Visualization	0	6,846

COMMAND CENTER VISUALIZATION: The purpose of this effort is to integrate and explore 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 will demonstrate the capability of emerging technologies to further automate and improve the warfighting operations of a command center resulting in improved speed of command and improved operational effectiveness with reduced manpower levels.

R9146	FY 02	FY 03
Improved Shipboard Combat Information Center (CIC)	0	3,521

IMPROVED SHIPBOARD COMBAT INFORMATION CENTER (CIC): The purpose of this effort is to integrate and explore various decision-making and display technologies for improving the CIC. This prototype system will demonstrate the capability of emerging technologies to further automate and improve the warfighting operations of surface ship combatant. The system will have technologies that can be re-configured depending on mission and tasking requirements and will allow CIC watchstanders to better receive, comprehend and respond to incoming data during combat operations. An improved shipboard CIC system will streamline and integrate information workflow, yielding improved speed of decision-making and improved operational effectiveness in combat situations.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: Warfighter Sustainment Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2915 Warfighter Sustainment Advanced Technology	55,291	56,273	53,132	56,053	62,973	65,650	66,939	68,273
R3008 High Speed Vessel		24,449						
R9021 Low Volume Production Technology	3,388	2,885						
R9022 National Center for Remanufacturing and Resource Recovery	963	0						
R9023 Commercial Off The Shelf (COTS) Carbon Fiber Qualification Program	966	1,467						
R9024 Distance Learning Information Technology (IT) Center	12,299	0						
R9147 Defense Systems Modernization and Readiness Initiative		3,913						
R9148 Emerging/Critical Interconnection Technologies Program (E/CIT)		977						
R9149 Energy and Environmental Technology		3,325						
R9150 Integrated Aircraft Health		1,663	1,662					
R9151 Wire Chaffing Detection Technology		1,368						
TOTAL	72,907	96,320	54,794	56,053	62,973	65,650	66,939	68,273

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION:

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: Warfighter Sustainment Advanced Technology

Warfighter Sustainment Advanced Technology supports: a) the Integrated Warfare Architecture (IWAR) Support Areas for Manpower and Personnel, Training, and Readiness; b) the IWAR Mission Areas; c) the Future Joint Warfighting Capabilities identified by the Joint Chiefs of Staff; and d) the Future Naval Capabilities (FNC) for Capable Manpower, 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. The High Speed Vessel develops technology to enable a future generation of fast ships for rapid movement of military payloads from CONUS to theater as well as within theater. Speeds of up to 70 knots will be considered. Increased payload fraction and reduced friction drag are key technical objectives. Technologies to be demonstrated include advanced hull forms, drag reduction, power dense propulsion, high strength-to-weight ratio structural materials, and rapid cargo handling.

Within the Naval Transformation Roadmap, this investment will support 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 the PE, the programs described are representative of the work included in this PE.

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	72,798	82,542	54,950	60,146
Adjustments from FY 2003 President's Budget:				
Congressional Adds		15,950		
Cong, Rescissions/Adjustments/Undist. Reductions	-352	-1,128		
Execution Adjustments	1,651			
NWCF Rate Adjustments			38	72
Efficiencies at NWCF Activities			-329	-324
S&T Program Adjustments			1,400	-2,632
Pay Raise/Inflation Adjustments		-1,044	-1,265	-1,209
SBIR Reduction	-1,190			
FY 2004/2005 President's Budget Submission:	72,907	96,320	54,794	56,053

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: Warfighter Sustainment Advanced Technology

PROGRAM CHANGE SUMMARY EXPLANATION:

Technical: Not Applicable.
Schedule: Not Applicable.

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

DATE: February 2003

BUDGET ACTIVITY: 3
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 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2915 Warfighter Sustainment Advanced Technology								
TOTAL	55,291	56,273	53,132	56,053	62,973	65,650	66,939	68,273

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program supports: a) the Integrated Warfare Architecture (IWAR) Support Areas for Manpower and Personnel, Training, and Readiness; b) the IWAR Mission Areas; c) the Future Joint Warfighting Capabilities identified by the Joint Chiefs of Staff; and d) the Future Naval Capabilities (FNC) for Capable Manpower, 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 program enable reduced operating costs through life-extension of legacy systems, increased efficiency of future propulsion systems and improved diagnostic tools. The Expeditionary Logistics investment is focused on Naval surface distribution in the areas of selective offload, at-sea arrival and assembly, and indefinite sustainment, and improves the situational awareness of readiness and operating logistics status

Within the Naval Transformation Roadmap, this investment will support 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:

	FY02	FY03	FY04	FY05
Manpower and Personnel Development	2,757	4,121	4,569	2,900

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. Fleet readiness is enhanced and personnel costs reduced via technologies such as modeling and simulation, mathematical optimization, advanced testing, statistical forecasting, information visualization, data warehousing, data cleansing, web-based knowledge management, and human performance measurement.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603236N PROJECT NUMBER: R2915
PROGRAM ELEMENT TITLE: Warfighter Sustainment Advanced Technology PROJECT TITLE: Warfighter Sustainment Advanced Technology

FY 2002 ACCOMPLISHMENTS

- Initiated Attrition Reduction Technologies. Tested measures and modified indices aimed at reducing attrition during the first year of service.
- Initiated Distribution Incentive System. Developed a baseline of various distribution incentive pay using simulations, experimental economics and surveys.
- Continued the development of the Rating Identification Engine (RIDE) algorithms and the Jobs and Occupational Interest in the Navy (JOIN) interest profiles.
- Continued Enlisted Manpower and Personnel Integrated Planning System (EMPIPS). Integrated the following: Minimal Statistical Summary Reports (MiniStats); Web Target; and Skilled Personnel Projection for Enlisted Retention (SKIPPER). Demonstrated a manpower and personnel planning tool as a single integrated system.
- Completed the Models of Navy Compensation and Personnel Behavior (MODCOMP). Delivered retention forecasting tool to Assistant Chief of Naval Personnel for Military Personnel Policy and Career Progression.
- Completed the Comprehensive Officer Force Management Environment (CHROME). Delivered in-year and out-year behavioral loss models to Military Personnel Plans and Policy Division.

FY 2003 PLANS

- Initiate Non-Cognitive Measures of Personality and Social Competency Related to Teamwork. Fully integrate psychometrics of measures into test plan.
- Initiate Enterprise Management System. Integrate database, statistical models and graphical user interface into decision support system.
- Initiate Career Case Manager Technologies. Develop a natural language interface for sailor/marine career queries and career management.
- Initiate Web Based Marketplace for Sailors and Jobs. Development of a web based market environment to facilitate the distribution and assignment of military personnel.
- Continue Attrition Reduction Technologies. Demonstrate person-organization fit model and integrate into attrition reduction model.
- Continue Distribution Incentive System: Develop incentive management prototype and analyze data associated with Sailor preference and propensities to volunteer for chronically difficult-to-fill locations and jobs.
- Continue the Enlisted Manpower and Personnel Integrated Planning System (EMPIPS). Complete the decision support systems, database, and documents integration efforts in EMPIPS. Incorporate the compensation models from the Models of Navy Compensation and Personnel Behavior (MODCOMP) into EMPIPS.

- Complete the Rating Identification Engine (RIDE) algorithms and the Jobs and Occupational Interest in the Navy (JOIN) interest profiles.
- Complete the aptitude interest model and transition algorithm to Navy Recruiting Command. Improved matching of recruit aptitude with initial job assignment will result in reduction in first-term attrition and increased reenlistments through enhanced job satisfaction.

FY 2004 PLANS

- Continue Non-Cognitive Measures and improve probability of adaptation to service, the person-organization-job fit/match to reduce attrition and improve first-term retention.
- Continue Attrition Reduction Technologies. Test measures and modify indices aimed at reducing attrition during the first year of service. This will provide a comprehensive system that contains Navy specific metrics on causes of attrition and low retention rates.
- Continue Distribution Incentive System, a real time distribution incentive system that allows the Navy to efficiently allocate a broad array of monetary and non-monetary distribution incentives.
- Continue Enterprise Management System. This product will enable personnel managers to recognize developing force management problems in time to prevent catastrophic actions/reactions.
- Continue Career Case Manager Technologies, a natural language interface that allows Sailors and Marines to effectively manage their military career.
- Continue Web-Based Marketplace for Sailors and Jobs. Develop intelligent agent technology for use as career and job negotiators for sailors, commands and detailers.
- Complete Enlisted Manpower & Personnel Integrated Planning system (EMPIPS) and provide an end-to-end view of personnel system that identifies and minimizes system inefficiencies.

FY 2005 PLANS

- Continue Enterprise Management System. Validate a suite of forecasts and trend models to provide an advanced warning system of changes in the external environment factors and internal policy impacts.
- Continue Career Case Manager Technologies. Test and validate natural language response items and validity of knowledge database.
- Continue Web-Based Marketplace for Sailors and Jobs. Test and validate rule based intelligent agent interface.
- Complete a comprehensive set of Attrition Reduction Technologies, indicators, and measures.

- Complete a series of Non-Cognitive Measures to determine personality and social competencies.
- Complete a set of business rules, and incentive structures in order to "incentivize" traditionally difficult-to-fill jobs and locations for the Distribution Incentive System.

	FY02	FY03	FY04	FY05
Training Systems	17,492	19,321	10,994	12,660

This effort improves mission effectiveness and safety by applying both simulation and instructional technology to the design of affordable education and training methods and systems. Focus is on the development and evaluation of systems to improve basic through advanced individual and team training, skill maintenance, and mission rehearsal capability. 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 2002 ACCOMPLISHMENTS

- Initiated the Prototype Virtual Technology/Environments for realistic Landing Craft Air Cushion (LCAC) and Advanced Amphibious Assault Vehicle (AAAV) simulators. Simulators improve coordination among crew members of driving and fighting vehicles to maintain and enhance combat readiness (VIRTE - DEMO I).
- Initiated the development of Battle Group Level Advanced Under Sea Warfare (USW) Visualization (VISTRA - BG) systems.
- Initiated Virtual At-Sea Training (VAST) task aimed at integrating existing technologies to produce an advanced prototype system to provide shipboard Naval Surface Fire Support (NSFS) training. The system combines live fire with synthetic targets and terrain to support realistic training at-sea, and constructive fire to support training dockside. The system includes an acoustic array to record the fall of shot from ship guns; the Battle Force Tactical Trainer (BFTT) to calculate shot trajectories and ship geo-location; the Joint Semi-Automated Forces (JSAF) system that contains authoritative models for targets, target terrain, and weapons; and ISMT-E, a Marine Corps spotter training system. Initiated a task to up-grade the acoustic scoring system component of VAST.
- Continued the development of Deployable Sonar Operations Training (DSOT).
- Continued the development of intelligent agents for real-time scenario modification for distributed exercises (HPA - IAGENTS).
- Completed the development of the Synthetic Cognition for Operational Team Training (SCOTT).
- Completed integration efforts leading to a preliminary demonstration of VAST at the Naval Surface Warfare Center NSWC-Dahlgren gun test range on the Potomac River.

FY 2003 PLANS

- Initiate the development of human performance assessment tools in support of the Navy-wide distributed learning training vision (HPA - ASSESS).
- Initiate the development of virtual technology and environments for close quarter combat (CQB) for military operations in urban terrain (VIRTE - DEMO II).
- Initiate task to design, test and demonstrate an expendable, buoy-based acoustic scoring system for Virtual At-Sea Training (VAST). Initiate task to develop enhanced technologies for real-time data transmission of scenario, participant status, force disposition, and spatial orientation information between airborne Naval combat air platforms and shore based simulator and simulation control systems. Initiate task to modify an existing common synthetic battlespace, now employed in the Fleet Battle Experiments, to support an integrated NSFS and AirVAST training constellation in support of combined operations. Initiate task to empirically evaluate deployed NSFS VAST systems to identify needed refinements and training effectiveness.
- Continue the development of collaborative networked visualization systems for sensor operations and training for operators and for Officers/Tacticians, at BG/Fleet/Theater level (VISTRA - DESRON)
- Continue task aimed at integrating existing technologies to produce an advanced prototype system providing shipboard Naval Surface Fire Support training. Continue up-grade the acoustic scoring system component of VAST.
- Complete the development of a Prototype Virtual Technology/Environments for realistic Landing Craft Air Cushion (LCAC) and Advanced Amphibious Assault Vehicle (AAAV) simulators. Simulators improve coordination among crew members of driving and fighting vehicles to maintain and enhance combat readiness (VIRTE - DEMO I).
- Complete the development of intelligent agents for real-time scenario modification for distributed exercises (HPA - IAGENTS).
- Complete the development of Deployable Sonar Operations Training (DSOT).

FY 2004 PLANS

- Initiate task to evaluate alternative ways to display information in the cockpit to support Naval air combat training in airborne platforms. Task to design advanced training technologies that uniquely exploit the training capabilities offered by the Virtual At-Sea Training (VAST) capabilities and to present scenarios to the air crew in the airborne cockpit and to stimulate airborne platform sensor systems while monitoring shipboard weapon systems in real time.
- Continue the development of human performance assessment tools in support of the Navy-wide distributed learning training vision (HPA - ASSESS).
- Continue the development of human performance assessment tools for distributed environments (HPA - ASSESS).

- Continue the development of collaborative networked visualization systems for sensor operations and training for operators and for Officers/Tacticians, at BG/Fleet/Theater level (VISTRA - DESRON).
- Continue the development of Virtual Technology and Environments (VIRTE) Demo II, Close Quarters Battle (CQB) for Military Operations in Urban Terrain (MOUT).
- Continue task to design, test and demonstrate an expendable, buoy-based acoustic scoring system for Virtual At-Sea Training (VAST). Continue task to develop enhanced technologies for real-time data transmission of scenario, participant status, force disposition, and spatial orientation information between airborne Naval combat air platforms and shore based simulator and simulation control systems. Continue task to modify an existing common synthetic battlespace, now employed in the Fleet Battle Experiments, to support an integrated NSFS and AirVAST training constellation in support of combined operations. Continue task to empirically evaluate deployed NSFS VAST systems to identify needed refinements and training effectiveness.
- Complete task aimed at integrating existing technologies to produce an advanced prototype system providing shipboard Naval Surface Fire Support training. Complete upgrade of acoustic scoring system for VAST.

FY 2005 PLANS

- Initiate development of collaborative networked visualization systems for Battlegroup and theater multi-sensor employment training, planning and decision support (VISTRA - BG).
- Initiate task to design an architecture to support integration of NSFS and AirVAST into a joint operations constellation that includes cross-echelon training for dismounted infantry, submarine-based land attack missile launch, United States Air Force Close Air Support (CAS) participation, and artillery crews in urban operations and amphibious assault.
- Continue the development of human performance assessment tools in support of the Navy-wide distributed learning training vision (HPA - ASSESS).
- Continue the development of Virtual Technology and Environments (VIRTE) Demo II, Close Quarters Battle (CQB) for Military Operations in Urban Terrain (MOUT).
- Continue task to design, test and demonstrate an expendable, buoy-based acoustic scoring system for Virtual At-Sea Training (VAST). Continue task to develop enhanced technologies for real-time data transmission of scenario, participant status, force disposition, and spatial orientation information between airborne Naval combat air platforms and shore based simulator and simulation control systems. Continue task to modify an existing common synthetic battlespace, now employed in the Fleet Battle Experiments, to support an integrated NSFS and AirVAST training constellation in support of combined operations. Continue task to empirically evaluate deployed NSFS VAST systems to identify needed refinements and training effectiveness.

- Continue task to evaluate alternative ways to display information in the cockpit to support Naval air combat training in airborne platforms. Continue task to design advanced training technologies that uniquely exploit the training capabilities offered by the Virtual At-Sea Training (VAST) capabilities to present scenarios to the air crew in the airborne cockpit and to stimulate airborne platform sensor systems while monitoring shipboard weapon systems in real time.
- Complete the development of collaborative visualization systems for sensor operations and training for operators and for Officers/Tacticians, at BG/Fleet/Theater level (VISTRA - DESRON).

	FY02	FY03	FY04	FY05
Human Systems Integration	380	1,073	1,316	1,141

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, extraction of software requirements, and development of software design models.

FY 2002 ACCOMPLISHMENTS

- Initiated a software architecture feasibility prototyping effort by interfacing to Tactical Tomahawk Weapons Control System's (TTWCS) Missile Manager Cell Preselection.
- Initiated development of a Transition Plan to include the products of this effort into future versions of TTWCS.
- Continued integration of Land Attack task and Human-Computer Interaction (HCI) designs into the rapid prototype.
- Continued evaluation of the integrated Land Attack rapid prototype and subsequent integration of lessons-learned into the rapid prototype.
- Continued design of a software architecture to accommodate a task-based user interface for Land Attack systems.
- Continued system assessment of legacy Land Attack systems and identification of requirements to accommodate the task-based user interface design.
- Continued extraction, logging, and tracing of task and HCI software requirements.
- Continued development of software design representation in Unified Modeling Language of the task and HCI designs.
- Continued development of Java reference code to test the generated software requirements and design.
- Completed development and testing of a software architecture feasibility prototyping effort with Missile Manager Cell Preselection.

FY 2003 PLANS

- Continue integration of Land Attack task and Human-Computer Interaction (HCI) designs into the rapid prototype.

- Continue evaluation of the integrated Land Attack rapid prototype and subsequent integration of lessons-learned into the rapid prototype.
- Continue design of a software architecture to accommodate a task-based user interface for Land Attack systems.
- Continue system assessment of legacy Land Attack systems and identification of requirements to accommodate the task-based user interface design
- Continue extraction, logging, and tracing of task and HCI software requirements.
- Continue development of software design representation in Unified Modeling Language of the task and HCI designs.
- Continue development of Java reference code to test the generated software requirements and design.
- Complete development of a transition plan for including the products of this effort into future versions of Tactical Tomahawk Weapons Control System's (TTWCS).

FY 2004 PLANS

- Initiate Land Attack Training Capability development and evaluation.
- Continue evaluation of the integrated Land Attack rapid prototype.
- Continue system assessment of legacy Land Attack systems and identification of requirements to accommodate the task-based user interface design.
- Continue extraction, logging, and tracing of task and Human-Computer Interaction (HCI) software requirements.
- Continue development of software design representation in Unified Modeling Language of the task and HCI designs.
- Continue development of Java reference code to test the generated software requirements and design.
- Complete integration of Land Attack task and HCI designs into the rapid prototype.
- Complete design of a software architecture to accommodate a task-based user interface for Land Attack systems.

FY 2005 PLANS

- Complete Land Attack Training Capability development and evaluation.
- Complete evaluation of the integrated Land Attack rapid prototype.
- Complete system assessment of legacy Land Attack systems and identification of requirements to accommodate the task-based user interface design.
- Complete extraction, logging, and tracing of task and Human-Computer Interaction (HCI) software requirements.
- Complete development of software design representation in Unified Modeling Language of the task and HCI designs.
- Complete development of Java reference code to test the generated software requirements and design.

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

DATE: February 2003

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: Warfighter Sustainment Advanced Technology

PROJECT NUMBER: R2915
PROJECT TITLE: Warfighter Sustainment Advanced Technology

	FY02	FY03	FY04	FY05
Turbine Engine Technology - Integrated High Performance Turbine Engine Technology (IHPTET)/ Versatile Affordable Advanced Turbine Engines (VAATE)	8,952	8,991	9,190	10,251

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 of doubling thrust-to-weight ratio, halving fuel consumption by the year 2005 (relative to a 1987 baseline) and reducing acquisition and maintenance costs. Additional emphasis has been incorporated to address High Cycle Fatigue issues, which may be associated with propulsion system design system deficiencies. This activity covers the Navy's share of the demonstrator engine efforts under the Department of Defense (DoD)/National Aeronautics and Space Administration (NASA) Industry IHPTET program, ensuring that Navy unique design and operational requirements are met. Full scale integrated technology demonstration is essential to validate and transition technologies from applied research through advanced development, program design review, and system development. Without technology demonstrators, system acquisition cost and schedule risk would increase to unacceptable levels or weapons systems would have degraded operational performance.

The lack of technology demonstrator efforts could result in system development schedule increases of five or more years along with the associated increase in cost and risk. The objective of VAATE, which is scheduled to begin 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. To achieve these goals, VAATE is organized into three interrelated focus areas, Durability; Intelligent Engine; and Versatile Core, that cover the three classes of turbine engines--Turbofan/Turbojet, Turboprop/Turboshaft, and Expendables. The Durability focus area has defined objectives that work to prevent component failure, predict and increase engine life and reliability, enhance repairability, improve inspection capability, and reduce operational deployment costs. The Intelligent Engine focus area has defined objectives that combine advanced aerodynamic, material, and structural concepts with emerging active control, health management, aircraft subsystem integration, and information technologies. The Versatile Core focus area has defined objectives that emphasize the development of maintenance friendly, low-emission, multi-use core engine technologies that enable a wide spectrum of affordable turbine-engine-based systems. VAATE is a DoD/DOE/NASA/industry program.

The technologies integrated into and demonstrated in the IHPTET demonstrator engines are closely related to the system requirements for the Joint Strike Fighter (JSF), F-18E/F, Multi-mission Maritime Aircraft (MMA), , SH-60R, and other future Navy platforms, so that the transition of these high risk and high payback technologies may be effectively accomplished. In addition, IHPTET technologies can transition to current legacy systems via engine Component Improvement Programs (CIP). A strong and viable U.S. propulsion program also provides a dual-use benefit to our country by enhancing our competitiveness in the international commercial engine market.

This long term activity, coordinated through Reliance, will provide for the future needs in air battlespace dominance and expeditionary forces support (Littoral Warfare Joint Mission Area (JMA), Increased platform mission endurance (Intelligence, Surveillance, and Reconnaissance JMA) and provide technology for increased affordability, platform survivability and increased mission effectiveness (Strike JMA). The activity funds three demonstrator engine classes.

Each engine class has specific performance goals that are divided into multiple phases. Phase I has been completed and demonstrated for each of the three classes of demonstrators. Phase II is currently underway in the engine demonstration phase, for all of the advanced component and system technologies. The Phase III concepts have been developed, and the design, integration and component technology efforts are being executed. The phase goals of each engine class are listed as follows and are referenced to a 1987 baseline (additional affordability goals have been developed for fighter/attack and turboprop/shaft classes).

Fighter/attack (Joint Technology Demonstrator Engine (JTDE)):
Phase I - 1991: +30% thrust/weight (Fn/Wt), +100 ^{O}F combustor inlet temperature (CIT), +300 ^{O}F turbine inlet temperature (TIT), -20% fuel burn.
Phase II - 1997: +60% Fn/Wt, +200 ^{O}F CIT, +600 ^{O}F TIT, -20% acquisition cost, -20% maintenance cost, -30% fuel burn.
Phase III - 2005: +100% Fn/Wt, +400^{O}F CIT, +900^{O}F TIT, -35% acquisition cost, -35% maintenance cost, -40% fuel burn.

Turboprop/shaft (Joint Turbine Advanced Gas Generator (JTAGG)):
Phase I - 1991: +40% shaft horsepower/weight (SHP/Wt), -20% specific fuel consumption (SFC), +300 ^{O}F TIT.
Phase II - 1997: +80% SHP/Wt, -30% SFC, +600 ^{O}F TIT, -20% acquisition cost, -20% maintenance cost.
Phase III - 2003: +120% SHP/Wt, -40% SFC, +1000 ^{O}F TIT, -35% acquisition cost, -35% maintenance cost.

Each engine company (Allison Advanced Development Company (AADC) (IN), Honeywell Engines and Systems (HES) (AZ), General Electric (GE) (OH & MA) and Pratt & Whitney (P&W) (CT & FL) attempts to utilize at least two engine builds or demonstrator tests within each Phase to demonstrate the performance and cost goals.

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

DATE: February 2003

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: Warfighter Sustainment Advanced Technology
PROJECT NUMBER: R2915
PROJECT TITLE: Warfighter Sustainment Advanced Technology

FY 2002 ACCOMPLISHMENTS

- Continued the Phase II Joint Technology Demonstrator Engine (JTDE): Fabrication, assembly, and instrumentation of General Electric (GE)/Allison Advanced Development Company (AADC) demonstrator engine.
- Continued the Phase III JTDE: Design, component development, integration and fabrication of Pratt & Whitney (P&W) and GE/AADC Phase III demonstrator engines.
- Continued the Phase III Joint Turbine Advanced Gas Generator (JTAGG): Design, component development, integration and fabrication of Honeywell Engine and Systems (HES) Phase III demonstrator engines.Continued the Phase II JTAGG: Component optimization and second build of HES demonstrator to meet Phase II goals.
- Completed the Phase II JTAGG: Component optimization and second build of HES demonstrator to meet Phase II goals.
- Completed the Phase III JTDE Preliminary Design Review of the GE/AADC demonstrator engine.

FY 2003 PLANS

- Continue the Phase II JTDE: Fabrication, assembly, and instrumentation of General Electric (GE)/Allison Advanced Development Company (AADC) demonstrator engine.
- Continue the Phase III JTDE: Component development, integration, fabrication, assembly and instrumentation of GE/AADC and P&W demonstrator engines and demonstration of P&W and GE/AADC progress toward Phase III goals.
- Continue the Phase III JTAGG: Component development, integration, fabrication and initial core test of HES demonstrator to meet Phase III goals.
- Complete the Phase II JTAGG: Component optimization and third build of HES demonstrator to meet Phase II goals.

FY 2004 PLANS

- Initiate VAATE Phase I: Component design and technology development to meet the VAATE Phase I goals.
- Continue the Phase III JTDE: Component development, integration, fabrication, assembly and instrumentation of GE/AADC and P&W demonstrator engines and demonstration of P&W and GE/AADC progress toward Phase III goals.
- Continue the Phase III JTAGG: Component development, integration, fabrication and initial test of HES demonstrator to meet Phase III goals.
- Continue the Phase II JTDE: Fabrication, assembly, instrumentation and initiate testing of General Electric (GE)/Allison Advanced Development Company (AADC) demonstrator engine.

FY 2005 PLANS

- Initiate VAATE Phase I: Design, component development, integration and fabrication of Phase I demonstrator engines.

- Continue VAATE Phase I: Component design and technology development to meet VAATE Phase I goals.
- Continue the Phase III JTDE: Component development, integration, fabrication, assembly and instrumentation of P&W demonstrator engines and demonstration of P&W progress toward Phase III goals.
- Continue VAATE Phase I: Component design and technology development to meet the VAATE Phase I goals.
- Complete the Phase III JTAGG: Component development, integration, fabrication and test of HES demonstrator to meet Phase III goals.
- Complete the Phase II JTDE: Fabrication, assembly, and instrumentation of General Electric (GE)/Allison Advanced Development Company (AADC) demonstrator engine for meeting the Phase II goals.
- Complete the Phase III JTDE: Component development, integration, fabrication, assembly and instrumentation of GE/AADC demonstrator engines and demonstration of Phase III goals with the GE/AADC demonstrator engines.

	FY02	FY03	FY04	FY05
Airframe/Ship Corrosion	3,875	3,900	4,808	4,343

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 2002 ACCOMPLISHMENTS

- Initiated development of a single coat system for ship tanks (ballast tank).
- Initiated the Airframe Corrosion effort.
- Initiated development of a modular hybrid pier (demo hull section).
- Initiated development of an advanced coating and inhibitor applied washdown system for United States Marine Corps (USMC) vehicles, awarded contract for road test facility.

FY 2003 PLANS

- Initiate the development of single coat system for ship tanks (potable water tank).
- Initiate the development of the road test methodology for USMC vehicle.
- Initiate the development of a modular hybrid pier (Demo joint modules).
- Continue the development of single coat systems for ship tanks (ballast tank).
- Continue Airframe Corrosion efforts.
- Continue the development of a modular hybrid pier (Demo hull section).

- Continue the development of advanced coatings and inhibitor applied washdown system for USMC vehicles.

FY 2004 PLANS

- Initiate the development of single coat systems for ship tanks (Fuel-Compensated fuel tank).
- Continue Airframe Corrosion efforts.
- Continue the development of a modular hybrid pier (Demo hull section).
- Continue the development of advanced coatings and inhibitor applied washdown system for USMC vehicles.
- Continue the development of single coat system for ship tanks (potable water tank).
- Continue the development of the road test methodology for USMC vehicle.
- Continue the development of a modular hybrid pier (Demo joint modules).
- Complete the development of single coat systems for ship tanks (ballast tank).

FY 2005 PLANS

- Initiate the development of single coat systems for ship tanks (Collection-Holding-Transfer Tanks (CHT)).
- Continue the development of single coat systems for ship tanks (Fuel-Compensated fuel tank).
- Continue Airframe Corrosion efforts.
- Continue the development of advanced coatings and inhibitor applied washdown system for USMC vehicles.
- Continue the development of the road test methodology for USMC vehicle.

- Complete the development of a modular hybrid pier (Demo Module Testbed).
- Complete the development of single coat system for ship tanks (potable water tank).

	FY02	FY03	FY04	FY05
Smart Wiring	2,372	2,061	526	0

Smart Wiring is a subset of the Total Ownership Cost (TOC) Future Naval Capability (FNC). Smart Wiring will develop flight-qualified smart aircraft wiring system hardware and perform required flight demonstrations. Smart wiring embeds diagnostic and prognostic technologies into aircraft wiring systems to manage wiring system health. The goals of smart wiring are (1) reduce wiring maintenance man-hours by 20%, (2) reduce wiring induced mission aborts and non-mission capable hours by 20%, and (3) reduce in-flight electrical fires and subsequent loss of aircraft by 80%. Total Oil Monitoring System (TOMS) will develop an oil system for in-situ oil analysis of an Advanced Amphibious Assault Vehicle (AAAV) critical mobility system/subsystem. The "total" aspect of the system combines oil debris and oil condition

monitoring with a wireless intra-vehicle data/information delivery capability. Benefits of the technology program will be increased readiness, reduced system TOC, reduction in Hazardous Materials (HAZMAT), and reduction in maintenance tasks.

FY 2002 ACCOMPLISHMENTS

- Initiated the development of updated requirements document for smart wiring system.
- Initiated an award and executed a contract to develop safety-of-flight qualified hardware for smart wiring system. Intent was to develop and implement diagnostic wiring system for aircraft. System will detect and isolate wiring gaults with minimal off-aircraft test equipment.
- Initiated and completed a test of the Total Oil Monitoring System (TOMS) with actual lubricants from host system.
- Initiated and completed an engine stand test for the Total Oil Monitoring System-Advanced Amphibious Assault Vehicle (TOMS-AAAV) integration. Intent was to provide capability to analyze fluids onboard the vehicle as would be done at an established oil lab. Onboard analysis increases readiness, reduces maintenance cost and reduces quantity of hazardous materials requiring disposal (old oil samples).

FY 2003 PLANS

- Initiate Total Oil Monitoring System (TOMS)/vehicle integration (electronics/software).
- Continue smart wiring hardware and software development, lab/bench test analysis, flight test planning/hardware assessment.
- Complete Total Oil Monitoring System (TOMS) development and integration.
- Complete smart wires aircraft suitability/requirements analysis.

FY 2004 PLANS

- Smart wires flight development/test/certification.

FY 2005 PLANS- Not Applicable.

	FY02	FY03	FY04	FY05
Littoral Combat	2,716	2,997	3,564	4,648

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. Position location information is a specific focus area to improve the quality of live fire training, using position location information with timely after action reporting.

FY 2002 ACCOMPLISHMENTS

- Initiated the development of an advanced Position Location Information (PLI) and range instrumentation system for live fire training and enhanced safety.

FY 2003 PLANS

- Continue development and integration of the Position Location Information and range instrumentation system to include After Action Review (AAR) capability.

FY 2004 PLANS

- Update the PLI system to include the capability to collect azimuth, elevation and time of fire from a mortar. Demonstrate in a scheduled training exercise and obtain user feedback to incorporate into system.

FY 2005 PLANS

- Finalize the PLI system and demonstrate in a scheduled training exercise. Transition to acquisition.

	FY 02	FY 03	FY 04	FY 05
Strike Up/Strike Down Selective Offload Systems	95	3,278	5,891	4,554

The Strike Up/Strike Down activity will produce new techniques and systems to automate the transfer of cargo from the shipboard unload point to stowage spaces (strike down), and from stowage to the offload point for ship-to-ship or shore transit (strike up) during high sea states. The three main focus areas are: Cargo Movement, Cargo Stowage and Selective Offload. New technologies will include linear electric drive induction motors, high-strength composites, ship-motion compensation for force control-based systems, and intelligent systems and robotics.

FY 2002 ACCOMPLISHMENTS

- Initiated the assessment of shipboard strike up/strike down for carriers and logistics ships transition candidates. Transition candidates include advanced weapons elevators, linear electric drive transport, omni-directional vehicle technology, and blast mitigation technologies for naval ammunition storage. Assessment was based on the contribution to seabased sustainment, selective offload, and technological viability.

- Initiated down selects of most promising technologies in selective offload, cargo movement and cargo stowage.
- Initiated mature technology transition plan with PEO Carriers and National Defense Sealift Fund.

FY 2003 PLANS

- Continue down-selection of promising technologies for shipboard strike up/strike down for carriers and logistics ships transition candidates. Transition candidates include advanced weapons elevators, linear electric drive transport, automated storage and retrieval systems, and blast mitigation technologies for naval ammunition storage.
- Continue mature technology transition plan with PEO Carriers and National Defense Sealift Fund.

FY 2004 PLANS

- 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 demonstration and testing, possibly linked with Seapower 21 seabasing demonstrations, for second group of matured capabilities in selective offload and strike up/down technologies.

	FY 02	FY 03	FY 04	FY 05
Seabase to Shore Surface Craft	0	1,873	2,276	0

These activity efforts will improve the capability for the transfer of personnel and cargo between sea base/logistics vessels and unimproved beaches during high sea states. It is necessary for indefinite sustainment of forces ashore, and is a key enabler for reconstitution and redeployment from a seabase. Initial technology will target Heavy Landing Craft Air Cushioned (LCAC) craft. The capabilities being developed include propulsion technologies, cargo stabilization technologies, advanced hull form technologies and the fabrication of lightweight robust structures that are needed for sustained operations at high speed in a moderate seaway.

FY 2002 ACCOMPLISHMENTS Not Applicable.

FY 2003 PLANS:

- Program initiation. Provided hydrodynamic modeling of a new propulsion system for the Heavy LCAC, addressing a 50% propulsion plant power increase in the same space.

FY 2004 PLANS:

- Complete hydrodynamic modeling and propulsion system technology exploration for the Heavy Landing Craft Air Cushioned Craft (HLCAC).

FY 2005 PLANS Not Applicable.

	FY 02	FY 03	FY 04	FY 05
Underway Replenishment/Material Transfer	3,803	937	5,018	5,196

These activity efforts will improve the 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. The capabilities being developed include load control, tensioned ropeways, and station keeping. Technology investment is focused on control systems, new materials, mathematical modeling and algorithm development, and new motor control and cooling principles.

FY 2002 ACCOMPLISHMENTS

- Initiated and completed a study of underway replenishment development of a 12K capacity system including station keeping and load control technologies, employing relative motion compensation, transfer load control and advanced materials.

FY 2003 PLANS

- Initiate development of a 12K underway connected replenishment capability with focused investment in algorithm development (mathematical modeling), and responsive controls for heavy loads (physical modeling). Materials investigation will continue through STTR program leveraging.
- Complete the mathematical modeling for the development of a 12K underway connected replenishment capability.

FY 2004 PLANS

- Continue the development of a 12K underway connected replenishment capability and responsive controls for heavy loads (physical modeling). Materials investigation will continue through Small Business Technology Transfer (STTR) program leveraging. Develop ship to ship positioning and load control systems and the development in motor response controls and motor cooling/heat dispersion.
- Complete the physical modeling for the development of a 12K underway connected replenishment capability.

FY 2005 PLANS

- Complete control system and heat dispersion development work. Conduct component demonstrations and complete transition to the National Defense Sealift office.

	FY 02	FY 03	FY 04	FY 05
High Speed Vessel Experiments	3,233	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 2002 ACCOMPLISHMENTS

- Initiated the program and instrumented the leased joint vessel for structural and sea-keeping data collection during experimentation runs. Participated in the joint analysis efforts.

FY 2003 PLANS

- Complete the conclusion of the effort. Remove hardware from the leased vessel. Complete report writing and analysis.

FY 2004 PLANS Not Applicable.

FY 2005 PLANS Not Applicable.

	FY 02	FY 03	FY 04	FY 05
At Sea Arrival And Assembly	0	1,873	1,879	3,630

This effort supports the seabasing mission of marrying troops to equipment, and providing support to seaborne forces via surface distribution interfaces.

FY 2002 ACCOMPLISHMENTS Not Applicable.

FY 2003 PLANS

- Initiate technology studies through hydrodynamic modeling and seaway motion analysis. Formulate technology development plans in fending, ship to ship securing, and seaway cargo handling to include roll on/off ramps and crane motion control.

FY 2004 PLANS

- Continue investment and technology development in ship to ship securing systems and seaway cargo handling technologies. Technology investment will include lightweight materials and control algorithms.

FY 2005 PLANS

- Continue investment and technology development in ship to ship securing systems and seaway cargo handling technologies. Technology investment will include lightweight materials and control algorithms. Begin at-sea demonstrations.

	FY 02	FY 03	FY 04	FY 05
Consumption Reduction	0	0	0	3,630

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 2002 ACCOMPLISHMENTS Not Applicable.

FY 2003 PLANS Not applicable

FY 2004 PLANS Not applicable

FY 2005 PLANS Not applicable

- Initiate technology exploration in advanced basing with reduced lift and manpower demands. Key focus areas are on construction principles and energy demand reduction.

	FY 02	FY 03	FY 04	FY 05
Logistics Command and Control (C2)	7,131	4,870	3,101	3,100

Seabasing will require not only improvement in lift and distribution, but also a concentrated effort to reduce demand. This effort will apply technologies that benefit battlefield consumption reduction. Initiatives include Power Generation and Alternative Energy.

FY 2002 ACCOMPLISHMENTS

- Initiated the development of the Combat Service Support Tool Kit software modules for the Logistics Commander ashore, addressing areas such as supply chain management on the tactical battlefield, and an improved situational awareness with the Marine Air-Ground Task Force (MAGTF) Commander.

FY 2003 PLANS

- Continue the development of the Combat Service Support Tool Kit software modules for the Logistics Commander ashore, addressing areas such as deliberate engineering, route reconnaissance, supply chain management on the tactical battlefield, and an improved situational awareness with the MAGTF commander.

FY 2004 PLANS

- Complete Combat Service Support Tool Kit software modules for the Logistics Commander ashore, addressing areas such as deliberate engineering, route reconnaissance, supply chain management on the tactical battlefield, and an improved situational awareness with the MAGTF commander.

FY 2005 PLANS

- Initiate development in support to the joint task force commander. Address seabourne asset visibility across the seabased spectrum, lift scheduling at the operational and tactical level, and a sustainment component to the common operating picture.

	FY02	FY03	FY04	FY05
Advanced Shipboard Crane Motion System ATD	2,485	697	0	0

The Advanced Shipboard Crane Motion Control System Advanced Technology Demonstration (ATD) demonstrates a crane control system that combines recent advances in nonlinear control system technologies with existing strategic Auxiliary Crane Ship electro-hydraulic cranes. The control scheme will control load pendulation through sea state three by applying nonlinear control algorithms, appropriate to the ship motion environment, to the shipboard crane control system and the crane operator commands. This technology will extend the capability for ship to lighterage transfer of expeditionary warfare logistics to at least 300 containers per day in sea state three.

FY 2002 ACCOMPLISHMENTS

- Completed a pendulation control system demonstration for shipboard cranes at pierside and at anchor, permitting ship-to-shore transfer of logistics through sea state three.
- Completed the design, procurement/fabrication of the sensor and control package. Installed crane simulator/trainer for military operator training and conduct a demonstration of test ship roll simulation system. Demonstrated pendulation control system at pierside and at anchor.
- Completed during November and December 2002 extensive demonstrations in Norfolk, VA that validated the control mechanism and algorithms.

FY 2003 PLANS

- Complete effort and conduct at sea demonstration, during military exercises, funded by NAVSEA. This program ends in FY03.

FY 2004 PLANS Not Applicable.

FY 2005 PLANS Not Applicable.

C. OTHER PROGRAM FUNDING SUMMARY:

RELATED RDT&E:

NAVY RELATED RDT&E:
PE 0206624M - Marine Corps Combat Services Support
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 - 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
PE 0601103D8Z - University Research Initiatives

D. ACQUISITION STRATEGY: Not applicable.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603236N PROJECT NUMBER: R3008
PROGRAM ELEMENT TITLE: Warfighter Sustainment Advanced Technology PROJECT TITLE: High Speed Vessel

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R3008 High Speed Vessel								
TOTAL		24,449						

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: 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.

	FY02	FY03	FY04	FY05
High Speed Vessel	0	24,449	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

B. PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 2002 ACCOMPLISHMENTS Not Applicable.

FY 2003 PLANS

- Initiate and complete the development of a hydrodynamic testing system for high speed vessels, capable of conducting hydrodynamic drag and lift testing at appropriate fluid velocities and Reynolds number, and of evaluating potential drag reduction approaches. Downselect to preferred testing approach and complete detailed design. Order materials and begin assembly of hydrodynamic testing system. Conduct assessment of drag reduction system concept, including polymer and micro-bubble approaches. Begin ship conceptual design studies. Assess state of the art in ship structural materials, establish materials technology requirements, and establish technical approach. Assess state of the art in high speed, power dense propulsion systems and establish technical approach.
- Initiate and complete the award of contracts for hydrodynamic testing system components, for structural and propulsion component demonstrations, and for design of a Composite High Speed Vessel (CHSV).

FY 2004 PLANS Not Applicable.

FY 2005 PLANS Not Applicable.

C. OTHER PROGRAM FUNDING SUMMARY:

RELATED 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.

CONGRESSIONAL PLUS-UPS:

R2739	FY02	FY03
Center for Integrated Manufacturing	*	0

Continued the effort started in FY01 to extend Navy oriented remanufacturing process research into condition assessment and technology insertion during system midlife. Develop a number of technology assessment and costing tools from private industry to more systematically deploy new technology in older systems, beginning with the design process. (*Appropriated in FY02 in PE 0603707N, $1,982)

R9022	FY02	FY03
National Center for Remanufacturing and Resource Recovery	963	0

Developed the methodology for military remanufacturing and resource recovery. Implemented a pilot study project by applying the military remanufacturing concept in a military environment.

R9023	FY02	FY03
Commercial Off The Shelf (COTS) Carbon Fiber Qualification Program	966	1,467

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. As part of the effort the contractor will complete the material properties database and will complete the qualification of this new low-cost, intermediate modulus carbon fiber.

R9024	FY02	FY03
Distance Learning Information Technology (IT) Center	12,299	0

Continued and expanded effort to standardize distance learning courseware and initiated an Advanced Distributed Learning (ADL) certification process.

R9147	FY02	FY03
Defense Systems Modernization and Readiness Initiative	0	3,913

Effort will continue work on systems modernization and readiness assessment and tracking. There are four specific focus areas in this effort: Material Aging, Life Cycle Engineering and Economic Decision System, Asset Health Management, Reliability Availability and Maintainability Initiative. These 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	FY02	FY03
For Emerging/Critical Interconnection Technologies Program (E/CIT)	0	977

The E/CIT will serve as a focus for the DoD to work with the U.S. electronic interconnection industry. The E/CIT will facilitate 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	FY02	FY03
Energy and Environmental Technology	*	3,325

Under Phases I and II of the Hawaii Energy and Environmental Technology Initiative, HNEI initiated research activities in fuel cell technologies and methane hydrates. A major accomplishment has been establishment of industrial partnerships to develop a state-of-the-art fuel cell test facility. As part of these partnerships, over $600,000 in equipment and infrastructure has been provided as cost-share. Activities during 2003 will include life testing and durability studies of Proton Exchange Membrane (PEM) fuel cells, development of transient characterization techniques to assess viability of PEM fuel cell systems for commercial and Naval applications, design and development of fuel cell systems for Navy specific needs such as unmanned undersea vehicles, and development of instrumentation for characterization of sea-floor methane hydrate resources. Teaming arrangements are also being put into place to include the Honolulu based Naval Undersea Warfare Center in fuel cell systems development and training activities.
(*Appropriated in FY02 In PE 0602805N, $2,499)

R9150	FY02	FY03	FY04
Integrated Aircraft Health	0	1,663	1,662

This effort will develop data interoperability software tools, diagnostic algorithms and processes to ensure improved affordability and safety through the application of integrated aircraft health management practices. The technology will enable reduced operating costs through life-extension of legacy systems and improved diagnostic tools that will decrease the number of unnecessary parts removals. FY04 Funding has been added to complete this FY03 Congressional Plus-up.

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

DATE: February 2003

BUDGET ACTIVITY: 3
PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: Warfighter Sustainment Advanced Technology
PROJECT NUMBER: Various
PROJECT TITLE: Congressional Plus-Ups

R9151	FY02	FY03
Wire Chaffing Detection Technology	*	1,368

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 will investigate, develop, demonstrate and transition technology to detect onset of wire chaffing in aircraft wiring and wiring harnesses. (*Appropriated in FY02 in PE 0602236N, $1,348)

R9021	FY02	FY03
Low Volume Production Program	3,388	2,885

Develop 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. Could increase the life cycle and performance of expensive new parts via protective claddings using laser weld technology.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603271N
PROGRAM ELEMENT TITLE: RF Systems Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2913 RF Systems Advanced Technology	69,650	63,626	45,475	36,571	53,330	53,494	54,538	55,599
R9025 Multi-Function, Multi-Band, Multi-Beam Communications Antenna System (M3CAS)	4,131							
R9152 Common Affordable Radar Processor (CARP)	0	4,156	0	0	0	0	0	0
R9153 E-2C Technical Upgrade for Optimized Radar	0	6,651	0	0	0	0	0	0
Total	73,781	74,433	45,475	36,571	53,330	53,494	54,538	55,599

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.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603271N
PROGRAM ELEMENT TITLE: RF Systems Advanced Technology

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	80,433	65,098	60,991	53,253
Adjustments from FY 2003 President's Budget:				
Congressional Plus-Ups		11,050		
Execution Adjustments	-4,818			
Congressional Rescissions/Adjustments/Undistributed Reduction	-390	-908		
SBIR Reduction	-1,444			
S&T Program Reductions			-14,189	-15,739
NWCF Rate Adjustments			-129	-11
Efficiencies at NWCF Activities			-149	-144
Pay Raise/Inflation Adjustments		-807	-1,049	-788
FY 2004/2005 President's Budget Submission:	73,781	74,433	45,475	36,571

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical: Not applicable

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2913 RF Systems Advanced Technology	69,650	63,626	45,475	36,571	53,330	53,494	54,538	55,599

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF Systems Advanced Technology

Project Number: R2913
Project Title: RF Systems Advanced Technology

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Work in this 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. The Radio Frequency (RF) Systems Advanced Technology 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 02	FY 03	FY 04	FY 05
Surface and Aerospace Surveillance Advanced RF Systems	16,465	14,707	9,184	7,198

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 2002 ACCOMPLISHMENTS:

- Under the Missile Defense (MD) Future Naval Capability (FNC), Littoral Affordability (classified program) completed its final year in this PE. It continues in FY 2003 as part of PE 0603123N.
- Under the MD FNC, the Ultra High Frequency (UHF) Electronically Scanned Array (UESA) E-2C antenna project was completed. Results of materials testing and structural analysis were provided to Naval Air Systems Command. This technology is now part of the Radar Test Bed in Hawaii (see below).
- Under the Time Critical Strike (TCS) FNC the initial design of a pod-mounted Precision Surveillance and Targeting (PS&T) radar system based on AN/APY-6 technology for in-flight captive carry for Navy F/A-18 aircraft was completed.
- The UESA Advanced Technology Demonstration completed in FY 2002 with delivery of a full scale electronically scanned array and composite dome designed to meet the E-2C requirements. The system will be installed at the Kauai, Hawaii Mountaintop test bed for integration and active radar testing.
- The Advanced Signal Processing (ASP) effort developed techniques for enhanced surveillance and tracking of air targets with airborne sensors.

FY 2003 PLANS:

- Under the TCS FNC, due to a change in program requirements, re-configure the design of the 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.
- Complete the ASP effort resulting in hardware for the Radar Modernization Program (RMP) demonstration and evaluation.
- Within the MD FNC Affordable Ground Based Radar (AGBR) effort, begin an advanced development model (ADM) for insertion into the USMC Multi-Role Radar System (MRRS) for development in the Fiscal Year 2005 time frame.

FY 2004 PLANS:

- 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.
- Within the MD FNC AGBR effort, continue fabrication of an ADM for insertion into the USMC Multi-Role Radar System development program.

FY 2005 PLANS:

- 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.
- Within the MD FNC AGBR effort, complete fabrication and testing of an ADM for the USMC Multi-Role Radar System development program in anticipation of a Milestone B decision in FY 2005.

	FY 02	FY 03	FY 04	FY 05
Radio Communications RF Advanced Technology	25,217	24,919	17,439	10,100

Radio Communications 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 2002 ACCOMPLISHMENTS:

- Awarded contract for system design and requirements studies which include development of a concept of operations and a military utility assessment for the Littoral Mobile Wireless Network.
- Initiated design and development of the Integrated Very High Frequency (VHF)/Ultra High Frequency (UHF)/L-Band (IVUL) aperture.

- Initiated development of an electronically steerable K/Ka/Q-Band phased array for communications applications.
- Initiated development of prototype demonstration hardware for a dual frequency, electronically steered X/Ku-Band radio frequency (RF) communications phased array to provide tactical data link connectivity to theater assets.
- Continued the development of the Naval Battleforce Network (NBN) to provide local communications relays for Amphibious Ready Groups. Initiated integration of: the airborne communications and multi-beam, multi-frequency antenna; littoral mobile wireless networking, and composite routing technologies into the NBN.
- Continued the development and initiated the testing of an S-Band Receive communications Phased Array prototype .

2003 PLANS:

- Continue the development of the NBN, and integrate: the airborne communications with multi-beam, multi-frequency antenna package; littoral mobile wireless networking, and composite routing technologies into the NBN.
- Continue development and initiate fabrication of an integrated VHF/UHF/L-Band aperture.
- Continue the development of a K/Ka/Q-Band electronically steered aperture.
- Continue 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 initiate sub system integration.
- Continue to conduct testing and evaluation of an S-Band receive phased array.

FY 2004 PLANS:

- Continue fabrication and assembly of a K/KA/Q-Band aperture program, and initiate testing and evaluation.
- Continue development and integration of the NBN.
- Complete development, demonstration and performance characterization of the integrated VHF/UHF/L-Band prototype antenna and transition to Naval Sea Systems (NAVSEA) Command for a planned FY05 at sea demonstration aboard a DDG platform.
- Complete 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.
- Complete integration and performance evaluation of the S-Band receive phased array and transition into the Naval Fires Network.

FY 2005 PLANS:

- Complete fabrication and assembly of a K/KA/Q-Band 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.

	FY 02	FY 03	FY 04	FY 05
Advanced Multi-Function RF Technology	27,968	24,000	18,852	19,273

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 2002 ACCOMPLISHMENTS:

- The Advanced Multi-function Radio Frequency Concept (AMRF-C) effort initiated integration and testing of a wideband multi-function Communication and Electronic Warfare test bed.
- Completed hardware development of AMRF-C subsystems including: a high band multi-function receiver, high band beam former and signal generator.
- The program completed the design, development, evaluation and documentation of the system resource allocation manager software, and completed development and implementation of real-time control software.

FY 2003 PLANS:

- The AMRF-C effort will complete integration and testing of a wideband multi-function Communication and Electronic Warfare test bed.
- The AMRF-C effort will demonstrate multiple simultaneous communication links with simultaneous electronic warfare receive and transmit functions to evaluate test bed functionality and to quantify an initial set of performance metrics and characteristics.
- The AMRF-C effort will evaluate and document system efficiencies while executing simultaneous transmit/receive functions; system resource management to include system scheduling, conflict resolution and adaptive response to changing operations and environments; and determination of isolation characteristics and interference issues that occur when conducting simultaneous functions using shared/common system elements. These metrics will 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 electronic warfare.
- The AMRF-C effort will include initial designs for wideband transmitter technology with power and linearity sufficient to support communications, electronic warfare and limited radar functions.
- The AMRF-C effort will continue demonstration of AMRF-C communications of EW testbed.

FY 2005 PLANS:

- 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 electronic warfare functions.
- The AMRF-C effort will complete demonstrations of communications and electronic warfare testbed.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603271N Project Number: R2913
PROGRAM ELEMENT TITLE: RF Systems Advanced Technology Project Title: RF Systems Advanced Technology

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.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603271N Project Number: Various
PROGRAM ELEMENT TITLE: RF Systems Advanced Technology Project Title: Congressional Plus-ups

Congressional Plus-Ups:

	FY 02	FY 03
R9025: Multi-Function, Multi-Band, Multi-Beam Communications Antenna System (M3CAS)	4,131	N/A

Multi-Function, Multi-Band, Multi-Beam Communications Antenna System (M3CAS): Funds provided have enabled the Navy's S&T RF communications programs that are developing multi-function, multi-band, multi-beam phased array apertures for Naval surface combatants to determine and address risk factors associated with platform integration and electromagnetic compatibility issues in the early stages of development. The M3CAS funding provided Navy developers and acquisition planners with engineering models for use in optimizing aperture placement aboard the host platform to maximize operational utility and effectiveness in all operating environments.

R9152: Common Affordable Radar Processor (CARP)	N/A	4,156

Common Affordable Radar Processor: Funds provided will focus on 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.

R9153: E-2C Technical Upgrade For Optimized Radar	N/A	6,651

E-2C Technical Upgrade For Optimized Radar: Funds provided will provide for development of a state of technology radar system/technology testbed concept which will support development and maturation of advanced technology enablers for the next generation E-2C Airborne Early Warning Radar system.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603508N
PROGRAM ELEMENT TITLE: Ship Propulsion System

COST: (Dollars in Thousands)

PROJECT NUMBER &TITLE	FY 2002 Actual	FY 2003 Estimate
R2826 Ship Service Fuel Cell	1,933	0
R9026 DDG-51 Composite Twisted Rudder	965	
Total	2,898	0

This PE was restructured in FY 2002.

Congressional Plus-ups appropriated in this PE are described under the following restructured program elements:

Title	PE Number	FY 2002
DDG-51 Composite Twisted Rudder	0603123N	$ 965
Reconfigurable Ships		
Ship Service Fuel Cell	0603123N	$1,933

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
C2297 Marine Corps Warfighting Lab-Core	39,814	43,528	37,693	36,604	37,661	35,754	36,852	37,575
C9154 Congressional Adds		4,135						
R2223 Marine Corps ATD	19,358	17,202	18,711	21,842	23,128	23,926	24,642	25,114
R2362 Extending the Littoral Battlespace	666	930						
R2995 California Central Coast Research Partnership (C3RP) Initiative	1,249	3,027						
R9028 Marine Corps Future Logistics	1,637							
R9029 Fast Refueling System	1,649							
R9290 Expeditionary Unit Water Purification Technology		6,148						
Total	64,373	74,970	56,404	58,446	60,789	59,680	61,494	62,689

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, 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 warfighting experimentation in conceptual operational assessment of emerging technologies is funded. This PE also provides Extending 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.

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	61,843	51,606	52,662	57,159
Adjustments from FY 2003 President's Budget:				
SBIR Adjustment	-1,104			
Execution Adjustments	+3,936			
S&T Adjustments			+5,000	+2,500
NWCF Rate Adjustments			+44	+47
Congressional Plus-Ups		+25,210		
Cong Rescissions/Adjustments/Undist. Reductions	-302	-1,032		
Pay Raise/Inflation Adjustments		-814	-1,302	-1,260
FY 2004/2005 President's Budget Submission:	64,373	74,970	56,404	58,446

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
C2297 Marine Corps Warfighting Lab-Core	39,814	43,528	37,693	36,604	37,661	35,754	36,852	37,575

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Marine Corps Warfighting Laboratory (MCWL) is the centerpiece experimental test bed for the operational enhancement 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 new technological developments and advanced concepts into the Operational Forces of the Marine Corps. Performing in the joint as well as individual service arena, MCWL focuses on developing and field testing future operational and technological concepts and serves as the focal point for the enhancement/refinement of future warfighting capabilities. The organizational thrust is to provide an institutional mechanism for continuously generating new ideas for warfighting capabilities. Concepts of operation are validated by means of various Warfighting Experiments.

Through a process of experimentation, which is designed as an ongoing mechanism to ensure the relevance of Marine forces in the face of change, MCWL experimentation encompasses inquiries into multiple technology and warfighting areas, including: Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) and Information Technology; Reconnaissance, Surveillance, and Target Acquisition (RSTA); Fires; Medical, Non-Lethal Technologies; Expeditionary Logistics; and Advanced Training and Education Techniques.

MCWL develops tactics, techniques, and procedures (TTPs) and evaluates advanced technologies that create or enhance future warfighting capabilities, and integrates them into the Marine Corps Expeditionary Force Development System. MCWL also provides all the efforts for Marine Corps Combat Development Command (MCCDC) Wargaming in support of the Expeditionary Force Development System and Experimentation.

Using operational forces, under the operational control of MCWL's own SPMAGTF(X), MCWL conducts a number of Advanced Warfighting Experiments (AWEs) supported by several 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 used in LTAs are gathered for use in larger 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. These AWEs examine an operational concept that envisions a greatly expanded, lethal, fluid, chaotic, and more opportunistic battlefield within a maneuver warfare approach. An AWE answers experimental issues under conditions most closely approximating conflict using the Advanced Warfighting Concept under examination. It further serves as a venue for integrating all warfighting functions for the purpose of integrated experimentation. All experimentation conducted during a phase builds toward the AWE.

- LOEs are considerably smaller in scope than AWEs and focus on a discrete set of closely related experiment objectives. These experimental forces will be highly trained, technologically infused, highly lethal, and intellectually prepared to fight in this chaotic and opportunistic environment. 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 technologies and equipment to assess their usefulness by means of analysis or experimentation. MCWL conducts LTAs in cases where the performance characteristics of developing technology are insufficiently documented to conduct operational planning necessary for experimentation. MCWL plans and conducts LTAs to effectively incorporate a technology into follow-on experiments.
- 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 Staff or SPMAGTF(X) Command Element (CE) to execute a Command Post Exercise (CPX) supported by extensive modeling and simulation (M&S). A Wargame is integral to MCWL's experimental process and precedes the execution of each LOE/AWE to refine the LOE/AWE Experimentation Plan. Wargames are also the primary means by which MCWL prepares for and supports Joint Experimentation conducted either in the form of Joint wargames or simulations using the emerging Distributed Continuous Experimentation Environment.
- 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. A Study can contribute to any stage of the Innovation and Experimentation Process, but is most useful during experiment planning.

Under the guidance of the Experimental Campaign Plan (ECP) (formerly known as Five Year Experimentation Plan (FYEP)), MCWL's prior accomplishments and current plans include six known AWE "build-up" phases culminating in actual AWE execution:

- Hunter Warrior: (March 1996 through April 1997) Experimented with advanced operational concepts and technologies on an extended and dispersed battlefield, in open and mountainous terrain at the mid-intensity operational level.

- Urban Warrior: (April 1997 through June 1999) focused on developing new TTPs and supporting technologies for operations in urban, close terrain, and near urban littoral areas.
- Joint Contingency Force (JCF) (also known as Millennium Dragon): (October 1999 through September 2000) Designed to identify, study, and improve new concepts and tactics for the Marine Corps under the auspices of the Operational Maneuver from the Sea (OMFTS) concept. In support of these concept-based experiments, new enabling technologies were developed, tested, and evaluated for operational use in a combat environment.
- Capable Warrior: (June 1999 through FY 2001) Used lessons learned in Hunter Warrior and Urban Warrior to integrate the full capability of a Marine Air-Ground Task Force (MAGTF) with naval units operating at the numbered fleet level of a Joint Task Force from the sea. Developed initial TTPs for an OMFTS force. Capable Warrior concluded with an experiment referred to as Kernel Blitz Experimental (KBX).
- Millennium Challenge 2002 (MC02): (FY 2001 through FY 2002) Congressionally mandated, Secretary of Defense directed, United States Joint Forces Command (USJFCOM) 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 critical future warfighting capabilities and forces at the operational level of war.
- Sea Viking 2004 (SV 04) (formerly known as Olympic Dragon): (FY 2002 through FY 2004) A series of related events that constitute near-term Marine Corps Service experimentation. SV 04 is also the first step in an experimentation program designed to transform the 1997 Ship-to-Objective Maneuver (STOM). SV 04 will culminate in a live force experiment conducted in the fall of 2004 by West Coast Navy and Marine Corps operating forces. Focus: The focus of SV 04 is "On the Move/Over the Horizon" Command and Control (OTM/OTH C2), with particular attention to the MAGTF's Command, Ground Combat, and Combat Service Support Elements.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
MCWL Operations (Support)	4,773	5,136	4,818	5,333

MCWL Operations (Support) efforts include overall MCWL experimentation doctrine, planning, wargaming, as well as transition efforts.

FY 2002 ACCOMPLISHMENTS: Initiated SV 04 AWE Experimentation Planning and technology investigations. Initiated Revolution in Military Affairs (RMA)/Project Ellis Program which is the Marine Corps component of the Office of the Secretary of Defense (OSD)/Net Assessment's RMA Wargaming Program. RMA provides an exploratory venue to address critical conceptual, organizational, and technical issues essential to success on the 21st century battlefield. Moreover, this program significantly strengthens Project Ellis as a process of accessing the impact of changes in the strategic landscape on concepts, organization, and technology. Continued Strategic Planning through the location, development, and evaluation of advanced warfighting operational and organizational concepts and related

enabling technologies. Synthesized results and lessons learned into proposed TTPs for the Marine Corps. Continued research; planning; modeling and simulation (M&S), concept, and wargame development; preparation; execution; and analysis and assessment to extend exploration of critical components. This includes investigations into Operations Other Than War (OOTW). Continued providing technical, strategic, and managerial support to the Marine Corps. Continued development and integration of new Marine Corps Tactics, Techniques, Technologies, and Procedures (TTTPs) in order to provide future Marine Corps capabilities in the areas of Doctrine, Organization, Training, Material, Leadership, Personnel, and Facilities (DOTMLPF). Completed Millennium Dragon 2002 Experimentation Planning and technology investigations

FY 2003 PLANS: Continue near term SV 04 planning focused on enhancing the capabilities of a deploying Amphibious Ready Group (ARG)/Marine Expeditionary Unit (MEU). Examine programs of record (POR) and experimental technologies developed with an eye toward achieving a significantly more capable force and assess the capability of these POR systems to support the STOM concept. Continue Strategic Planning through the location, development, and evaluation of advanced warfighting operational and organizational concepts and related enabling technologies. Synthesize results and lessons learned into proposed TTPs for the Marine Corps. Expand investigations into transition avenues for maturing TTTPs. Continue research; planning; M&S, concept, and wargame development; preparation; execution; and analysis and assessment to extend exploration of critical components. Continue providing technical, strategic, and managerial support to the Marine Corps. Continue development and integration of Marine Corps DOTMLPF recommendations. Continue RMA/Project Ellis efforts. Continued Science and Technology Operations Information Center (STOIC) development, an Information Management Database System used to support MCWL.

FY 2004 PLANS: Conclude the SV04 AWE Experimentation Planning and technology investigations. Continue Strategic Planning efforts. Continue investigations into transition avenues for maturing TTTPs. Synthesize results and lessons learned into proposed DOTMLPF recommendations for the Marine Corps. Continue research; planning; M&S, concept, and wargame development; preparation; execution; and analysis and assessment to extend exploration of critical components. Continue providing technical, strategic, and managerial support to Marine Corps Experimentation. Continue to refine and extend established wargaming programs, and explore and develop innovative research and gaming methods and techniques to include “next generation” M&S capabilities. Continue STOIC development efforts.

FY 2005 PLANS: Continue Strategic Planning efforts. Continue investigations into transition avenues for maturing TTTPs. Synthesize results and lessons learned into proposed DOTMLPF for the Marine Corps. Continue research; planning; M&S, concept, and wargame development; preparation; execution; and analysis and assessment to extend exploration of critical components. Continue providing technical, strategic, and managerial support to Marine Corps Experimentation. Continue to refine and extend established wargaming programs, and explore and develop innovative research and gaming methods and techniques to include “next generation” M&S capabilities.

	FY 02	FY 03	FY 04	FY 05

Command, Control, Communications, Computers, and Intelligence (C4I)	9,184	9,628	9,481	8,911

This section encompasses all MCWL C4I related experimentation efforts.

FY 2002 ACCOMPLISHMENTS: Initiated Integrated Global Positioning System (GPS) Radio System (IGRS) effort to aid in data collection efforts. Initiated research and experimentation with Voice Over Internet Protocol (IP) (VoIP) technologies. Expanded Marine Corps Interface Module (Airborne) (MCIM)(A) research experimentation efforts. Continued to develop information processing and to further integrate capabilities into the Integrated Marine Multi-Agent Command and Control System (IMMACCS) and the C4 Lab facility. Initiated effort to experiment with Over the Horizon (OTH) communications technologies. Continued to develop enhanced capability for Shared Net and IMMACCS Graphical User Interface (GUI) communications/situational awareness technology. Continued to refine capability for the IMMACCS Agent Engine. Continued to evaluate the effectiveness of commercially available (off-the-shelf) technology for providing wireless connectivity for the small units. Curtailed voice recognition software research. Continued investigation into technology alternatives to C4 Lab. Incorporated lessons learned from Capable Warrior AWE into ongoing technical development efforts and assisted Limited Objective Experiments (LOEs) planned in preparation for Millennium Dragon 2002 AWE.

FY 2003 PLANS: Initiate experimental planning and C4ISR development to support the SV 04 Advance Warfighting Experiments (AWE). Continue to develop information processing and to further integrate capabilities into the IMMACCS and the C4 Lab facility. Continue to develop enhanced capability for Shared Net and IMMACCS GUI (now referred to as Command and Control Integration (CCI)) efforts. Initiate development of intelligent agent decision support tools. 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/expand alternative OTH communications technology investigations. Initiate efforts to constitute a Digital Combat Operations Center (DCOC) and On the Move/Combat Operational Center (OTM/COC) capability. Completed IGRS data collection efforts. Expand experimentation and integration of the intra-squad radio systems.

FY 2004 PLANS: Provide Command, control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) support for the SV 04 AWE. Continue to develop information processing and to further integrate capabilities into the C4 Lab facility. Continue to develop intelligent agent decision support tools. 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 and voice translation efforts. Investigate collaborative planning capabilities. Investigate tactics, techniques, and procedures (TTPs) and technologies of a Navy/Marine seabased COC. Continue experimentation and development of intra-squad radio systems. Continue to search for new and emerging technologies.

FY 2005 PLANS: Continue to develop information processing and to further integrate capabilities into the C4 Lab facility. Continue to develop intelligent agent decision support tools. Continue to conduct experiments and evaluate the performance of advanced C2 capabilities to support 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 and voice translation efforts. Continue to investigate collaborative planning capabilities. Continue to investigate TTPs and technologies of a Navy/Marine seabased COC. Continue experimentation and development of intra-squad radio systems. Continue to search for new and emerging technologies.

	FY 02	FY 03	FY 04	FY 05
Drones, Aviation, Sensors, and Vehicles	7,277	6,141	7,246	7,541

This section includes MCWL experimentation efforts involving drones, aviation aspects, sensors, and vehicles.

FY 2002 ACCOMPLISHMENTS: Continued small payload development for Dragon Warrior Unmanned Aerial Vehicle (UAV). Experimented with adding laser designation capability to Dragon Warrior Electro-optic/Infrared (EO/IR) payload. Continued Dragon Eye UAV investigations/ experimentation. Continue sensor technology investigations/ experimentation. Initiated Dragon Runner Mobile Ground Sensor (MGS) development/experimentation 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. Expanded M3M machine gun mounted on helicopter platforms (UH-1N, CH-53E, and CH-46E) experimentation. Continued aviation experimentation in the urban environment and aviation based simulation/instrumentation efforts. Continued to search for new and emerging technologies

FY 2003 PLANS: Reduce small payload development for Dragon Warrior UAV. Continue Dragon Eye UAV investigations/experimentation. Continue sensor technology investigations/experimentation. Continue investigations/experimentation in aviation technologies that could lead to increasing accuracy and effectiveness of Close Air Support missions and also reduce the possibility of fratricide. Expand/refine Dragon Runner MGS efforts. Continue UGV payload and micro UAV/UGV payload development efforts. Continue M3M mounted on helicopter platforms experimentation. Continue aviation experimentation in the urban environment and aviation based simulation/instrumentation efforts. Continue to search for new and emerging technologies.

FY 2004 PLANS: Continue small payload development for Dragon Warrior UAV. Continue Dragon Eye UAV experimentation and refinement of tactics, techniques, and procedures (TTPs). Expand development of the Local Area Sensor System (LASS). Continue investigations/ experimentation in aviation technologies that could lead to increasing accuracy and effectiveness of Close Air Support missions and also reduce the possibility of fratricide. Continue UGV payload and micro UAV/UGV payload development efforts. Continue Dragon Runner MGS efforts. Complete M3M mounted

on helicopter platforms experimentation. Continue aviation experimentation in the urban environment and aviation based simulation/ instrumentation efforts. Continue to search for new and emerging technologies.

FY 2005 PLANS: Continue small payload development for Dragon Warrior UAV. Continue Dragon Eye UAV experimentation and refinement of TTPs. Continue LASS development efforts. Continue UGV payload and micro UAV/UGV payload development efforts. Continue investigations/experimentation in aviation technologies that could lead to increasing accuracy and effectiveness of Close Air Support missions and also reduce the possibility of fratricide. Continue Dragon Runner MGS efforts. Investigate capabilities to enhance tactical mobility of a vertical maneuver element. Continue aviation experimentation in the urban environment and aviation based simulation/instrumentation efforts. Continue to search for new and emerging technologies.

	FY 02	FY 03	FY 04	FY 05
Fires, Targeting, and Maneuver	4,170	3,315	3,484	3,830

This section includes MCWL experimentation efforts in the areas of firing, targeting, and maneuverability.

FY 2002 ACCOMPLISHMENTS: Under previously titled Mobile Fire Support System (MFSS) concept demonstrator program, participated in a Comparative Demonstration (CD) series to measure differences in precision between 120 millimeter (mm) rifled (MCWL's MFSS) and smoothbore ammunition (Army's version) and conducted Limited Technology Assessments (LTAs) of Light Armored Vehicle (LAV)-mounted and towed advanced technology mortar systems with First Marine Expeditionary Force (I MEF). Wrote development plan, detailed specifications, and project plan for the next-generation automated firing system, the Dragon Fire II. Completed the design and modification of a standard LAV to become a modular platform for the Dragon Fire I and II systems. Completed the experimentation of the Mortar Ballistic Computer (MBC). The MBC is a system to provide accurate technical fire control for the 81 mm and 60 mm mortars in the Marine Corps inventory. Continued efforts evaluating laser rangefinder capabilities. Formerly known as Advanced Close Air Support System (ACASS), continued assistance of the Target Handoff System (Experimental) (THS(X)) development including a vehicle-mounted precision targeting variant. Initiated project to develop a lightweight and expeditionary fires coordination system. Continued to investigate emerging fires and targeting technologies.

FY 2003 PLANS: Continue breach loading capability redesign and fabrication efforts of the fully functional Dragon Fire I concept demonstrator. Conduct the 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. Conduct LTAs firing the Dragon Fire I from the modular LAV testbed. Continue laser rangefinder investigations/experimentation. Continue support for the development of the THS(X). Continue Expeditionary Fires Coordination System (EFCS) development. Continue to investigate emerging fires and targeting technologies. As augmentation to the Mobile Counter Fire System (MCFS) Congressional enhancement, provide continued system development.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations

FY 2004 PLANS: Complete first Dragon Fire II concept demonstrator and conduct proof firings, instrumented firings, and ballistic kernel verification/modification. Continue laser rangefinder investigations/experimentation. Complete THS(X) development and transition to the Marine Corps Systems Command (MCSC). Deliver working EFCS and conduct LTAs to test its performance against the design specifications. Continue exploration of precision targeting technologies and systems. Continue development of modular design for fire support systems using the Dragon Fire/LAV testbed and begin the development of the "Fire on the Move" technology. Continue to search for new and emerging technologies.

FY 2005 PLANS: Continue Dragon Fire II concept demonstrator evaluations. Continue laser rangefinder investigations/experimentation. Continue EFCS demonstration/evaluation. Continue exploration of precision targeting technologies and systems. Continue development of modular design for fire support systems using the Dragon Fire/LAV testbed. Continue development of the "Fire on the Move" technology. Initiate investigations into highly mobile, internally transportable counter-fire radar to support a vertical maneuver element. Continue to search for new and emerging technologies.

	FY 02	FY 03	FY 04	FY 05
Seabasing, Logistics, Combat Service Support (CSS), and Combat in the Cities	3,299	6,701	11,080	9,342

This section includes MCWL experimentation efforts involving seabasing, logistics, CSS, urban combat, as well as training and education.

FY 2002 ACCOMPLISHMENTS: Established minimal Tactical Warrior experimentation program to explore expanded tactical capabilities in the infantry platoon and company through changes in organization and the exploitation of changes in available training and technology. Initiated M3M machine gun ground experimentation by mounting the system on three vehicle platforms (High Mobility Multi-purpose Wheeled Vehicle (HMMWV), 5-ton truck, and 7-ton truck). Initiated SEAWAY-LOGGY program to provide a set of adaptive command and control tools to support the planning and execution of expeditionary operations. SEAWAY-LOGGY is an object-based software tool kit that incorporates the Integrated Cooperative Decision Making (ICDM) architecture and employs expert system technology for analysis, evaluation, and projection. It is a candidate to become a segment within the Common Logistics Command and Control System (CLC2S) program of record. Initiated preliminary investigations into the Joint High Speed Vessel (JHSV) program to explore the concepts and capabilities with commercially available advanced hull and propulsion technology. Continued to develop and integrate the CSS tools/systems/equipment that will support the "Marine of 2020". Continued to invest in all types of simulation to allow required OMFTS warfighting capabilities to be tested. Continued to search for, evaluate, and perform seabased logistics support and seabasing analysis. Continued investigation/development of a system that tracks personnel involved in Non-combatant Evacuation Operations. Continued rapid prototype development, demonstration, and transition of logistics information

resources technologies. Continued system concept M&S support for decision support and technology plan development for Joint Expeditionary Forces. Continued to investigate and incorporate automated information technologies for asset tracking, interactive, condition based maintenance support, and sensored logistics information feeds. Continued integrating clothing and equipment that will enhance Marines' survivability. 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 a system of realistic warfighting that will allow 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, techniques, procedures, and technologies of the individual Marine to better enable him to fight and survive in the expeditionary combat environments. Continued to experiment with electronic markers. Continued to leverage ongoing work in the Day/Night Small Unit Target Acquisition and Small Unit Logistics fields. Continued to evaluate CSS for emerging and developing weapons as they apply to operational concepts of logistics support and sustainment for various non-standard scenarios. Continued investigations into existing and emerging training enhancements and simulation equipment and devices. Continued Ground Command and Control (GLC2) efforts. Expanded Joint Experimentation Cell investigation/coordination efforts. Continued Urban Ground Reconnaissance efforts. Completed Guided Parafoil Aerial Delivery System (GPADS) efforts, which included investigations into spare parachute canopies and attachments, as well as obtaining C-130 flight clearance. Completed Night Integrated Training Environment (NITE) Lab support efforts. The NITE Lab is an indoor, year-round, multi-environment training facility.

FY 2003 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 enhanced seabased logistics capabilities. Expand prototype development, demonstration, and transition of logistics decision support systems. Establish 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. Establish a Mine Counter Measures (MCM) initiative to develop and assess the TTTPs surrounding a MEU MCM Capability Set. Continue integrating clothing and equipment that will enhance Marines' survivability. Continue MOUT experimentation efforts to include Project Metropolis and Project Rifleman. Continue to experiment with electronic markers. Continue investigations into existing and emerging training enhancements and simulation equipment and devices. Continue to search for and to evaluate emerging commercially available technologies that could significantly improve efforts in this area. Assess Land Warrior technologies for Marine Corps application. Investigate Marine Corps and Special Operations Command (SOCOM) TTPs and Technology collaboration. Land Warrior is an integrated computer/weapon system worn by the individual Marine. Continue M3M mounted on vehicle platforms experimentation. Continue SEAWAY-LOGGY efforts – resulting in support to Marine Corps Material Command and the CSS Advocate in assessing the value of the SEAWAY LOGGY 2.0 software during July 2003. Expand JHSV program efforts to explore the concepts and capabilities with commercially available advanced hull and propulsion technology. Continue Urban Ground Reconnaissance efforts. As augmentation to the Center for Emerging Threats and Opportunities (CETO) Congressional enhancement, provide support for asymmetric warfare studies/investigations.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations

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 enhanced seabased logistics capabilities. Continue prototype development, demonstration, and transition of logistics decision support systems. Continue development of the MUTT initiative. Continue development of MCM initiative. Continue to investigate individual equipment to enhance Marines' survivability and combat effectiveness. Continue MOUT experimentation efforts. Continue investigations into existing and emerging training enhancements and simulation equipment and devices. Continue to assess utility of Land Warrior technologies for Marine Corps application. Continue Marine Corps and SOCOM TTPs and Technology collaboration. Expand JHSV efforts. Complete M3M mounted on vehicle platforms experimentation. Continue Urban Ground Reconnaissance efforts. Continue to search for new and emerging technologies.

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 enhanced seabased logistics capabilities. Continue prototype development, demonstration, and transition of logistics decision support systems. Continue MUTT and MCM development/experimentation efforts. Continue to investigate individual equipment to enhance Marines' survivability and combat effectiveness. Continue MOUT experimentation efforts. Continue investigations into existing and emerging training enhancements and simulation equipment and devices. Continue to assess utility of Land Warrior technologies for Marine Corps application. Continue Marine Corps and SOCOM TTPs and Technology collaboration. Continue JHSV efforts. Continue Urban Ground Reconnaissance efforts. Continue to search for new and emerging technologies.

	FY 02	FY 03	FY 04	FY 05
Medical, Analysis, and Non-Lethal	1,732	1,265	1,584	1,647

This section includes MCWL experimentation efforts in the areas of medicine, analysis, data collection, and Non-Lethal weapons/technologies.

FY 2002 ACCOMPLISHMENTS: Continued medical investigations, to include health effects of thermobaric weapons, homeostatic dressings, and en-route medical care. Continued to define the scope, nature, technical utilities, and TTPs that support domestic and international responses to the human and material casualties of a Weapons of Mass Destruction (WMD) deployment. Continued to support instrumentation capability that provides battlespace instrumentation for experimentation. Continued efforts to improve upon the automated data collection system. Continued to provide overall systems engineering and integration support for ongoing experimentation. Continued to provide overall analysis and reporting of experimentation efforts. Continued limited investigations into seeking Non-Lethal technologies that can affect an opponent's infrastructure without necessarily destroying it. Continued limited investigations into the use of Non-Lethal technologies to deter, delay, deny, disrupt, and destroy opponents or their material.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations

FY 2003 PLANS: Continue to investigate enhanced medical TTPs and technologies. Continue to support instrumentation capability that provides battlespace instrumentation for experimentation. Continue efforts to improve upon the automated data collection system. Continue to provide overall systems engineering and integration support for ongoing experimentation. Continue to provide overall analysis and reporting of experimentation efforts. Continue to explore emerging Non-Lethal technologies.

FY 2004 PLANS: Continue to investigate enhanced medical TTPs and technologies. Continue battlespace instrumentation experimentation efforts. Continue efforts to improve upon the automated data collection system. Continue to provide overall systems engineering and integration support for ongoing experimentation. Continue to provide overall analysis and reporting of experimentation efforts. Continue to explore emerging Non-Lethal technologies. Continue to search for new and emerging technologies.

FY 2005 PLANS: Continue to investigate enhanced medical TTPs and technologies. Continue battlespace instrumentation experimentation efforts. Continue efforts to improve upon the automated data collection system. Continue to provide overall systems engineering and integration support for ongoing experimentation. Continue to provide overall analysis and reporting of experimentation efforts. Continue to explore emerging Non-Lethal technologies. Continue to search for new and emerging technologies.

	FY 02	FY 03	FY 04	FY 05
Thermobarics	3,070	0	0	0

This section describes Marine Corps Systems Command's (MCSC's) Ground Weapons thermobaric warhead efforts.

FY 2002 ACCOMPLISHMENTS: The Shoulder-Launched Multipurpose Assault Weapon (SMAW) thermobaric warhead is an addition to the family of warheads already fielded. This warhead will provide an immediate capability to clear caves in addition to be employed in the Military Operations in Urban Terrain (MOUT) environment. Fiscal Year 2002 provided for Phase I efforts of development, integration, and demonstration.

FY 2003 PLANS: Not applicable

FY 2004 PLANS: Not applicable

FY 2005 PLANS: Not applicable

Congressional Plus-Ups

	FY 02	FY 03
Project Albert	3,881	5,817

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations

FY 2002 ACCOMPLISHMENTS: The Project Albert goal is to generate data to support warfighting hypotheses with emphasis on questions relating to urban warfare. Project Albert provides design and development of new tools to capture emergent behavior in synthetic environments that, over time, will lead to more effective maneuver warriors. Project Albert continued efforts to support decision-making in a co-evolving world through developing data, concepts, and tools of 21st Century Operations Analysis especially in the areas of non-linear and asymmetric warfare. During FY 2002, Project Albert accomplishments included: 1) Development of realistic agent-based models of combat with an emphasis on building a toolkit with a variety of ways to treat command and control, communication, combat, terrain, and decision making; 2) Designed and analyzed an influence network (use of Bayesian decision analysis) on a counter terrorist scenario; 3) Developed a Parallel Execution System so that gridded search, evolutionary, and co-evolutionary studies can be accomplished quickly and easily; 4) Developed a scenario translation capability from the ISAAC model to the SOCRATES model, for use in validating operational concepts across levels of resolution; 5) Continued research on the dynamics of competition, with the goal of implementing innovative ideas within military modeling and analysis; 6) Continued implementation of innovative approaches in data perception and understanding into the analysis tools that comprise the Albert toolkit; and 7) Evaluated technical, analytical, and administrative data leading to the development of an integrated and validated capabilities-based Expeditionary Maneuver Warfare (EMW) Command and Control Plan

FY 2003 PLANS: The goal of Project Albert is to investigate and apply promising technologies to support military decision-makers in meaningful ways through modeling, analysis, and new ways of combining them to include important phenomena inadequately represented by current techniques. In FY 2003 models and developing Data Farming techniques are 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 is to understand the large landscape of possibilities in our changing world environment and the second is 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 will include surf zone/beach obstacle reduction and mine countermeasures, 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.

	FY 02	FY 03
Mobile Counter-Fire System (MCFS)	2,428	2,445

MCFS is a sniper detection system. It is intended to provide the war fighter a means of detecting the origin of incoming sniper fire. The MCFS uses acoustic sensors to track bullet flight, determine the location of the shooter(s), and remotely slew a crew-served weapon toward the shooter(s). The operator is then able to return fire or report the shooter’s location. An effective MCFS will remove the ability of enemy snipers to fire well-aimed second and subsequent shots from the same firing position, thus increasing force protection.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations

FY 2002 ACCOMPLISHMENTS: Limited evaluations were performed on a single platform (High Mobility Multi-purpose Wheeled Vehicle (HMMWV)) prototype system with a baseline software system. In addition, algorithm research was conducted to address false-alarm issues.

FY 2003 PLANS: Allow for improvements to the MCFS in the areas of correcting previously identified problems, repackaging Fire Control and Sniper Detection systems, increase areas of vehicle protection, increase accuracy of vehicle location coordinates, incorporate a laser range finder, addition of calibration circuits, and to conduct system experimentation.

	FY 02	FY 03
Advanced Light Strike Vehicle (ALSV)	0	3,080

FY 2003 PLANS: This synergistic effort capitalizes upon lessons learned from the Internally Transportable Vehicle and the Reconnaissance Surveillance Targeting Acquisition Vehicle teaming Marine Corps, Navy and industry subject matter experts (SMEs) to investigate promising technologies leading to an effective, combat suitable, ALSV. This effort begins 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.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0602131M Marine Corps Landing Force Technology

NON-NAVY RELATED RDT&E: Not applicable

D. ACQUISITION STRATEGY: Not applicable

BUDGET ACTIVITY:3 PROGRAM ELEMENT: 0603640M Project Number: R2223
PROGRAM ELEMENT TITLE: Marine Corps Advanced Technology Demonstrations Project Title: Marine Corps ATD

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2223 Marine Corps ATD	19,358	17,202	18,711	21,842	23,128	23,926	24,642	25,114

MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: As the land warfare component of Naval Expeditionary Forces power projection, the Marine Corps has unique and technologically stressing requirements that result from: Mission; Marine Air-Ground Task Force (MAGTF) organizational structure; and reliance on maneuver, logistic sustainability, and intensive tempo of operations in diverse environments. Critical Marine Corps requirements/imperatives addressed in this Project are: Maneuver; Firepower; Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR); Logistics; 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. Joint service efforts are in line with Defense Technology Objectives (DTOs) and Joint Warfighting Objectives (JWOs).

In addition, this project supports the goals and objectives of the Littoral Combat Future Naval Capabilities (FNC) process. 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 Intelligence, surveillance and Reconnaissance (ISR) key transformational capabilities within Sea Strike and the enhanced Sea-borne Positioning of Joint Assets within Sea Basing.

B. ACCOMPLISHMENTS/PLANNED PROGRAMS:

	FY 02	FY 03	FY 04	FY 05
Command, Control, Communications, Computers, and Intelligence, Surveillance and Reconnaissance (C4ISR)	2,116	2,600	3,253	4,000

This activity demonstrates enhanced communications and situational awareness in warfighting environments and communication technologies for near term USMC operations.

FY 2002 ACCOMPLISHMENTS:

- Completed integration of Mobile Direction Finding capability (moved from 0602131M) for transition to the Team Portable Collection System program.
- Completed Command, Control, Communications, Computers, and Intelligence (C4I) Gateway integration and demonstration. Supported and participated in Millennium Challenge Joint Exercise.

FY 2003 PLANS:

- Migrate fully-functional Command and Control Technology testbed into systems integration environment for user prototyping, and requirements generation on prospective commercial and developmental software products.
- Initiate demonstration of Low-Probability of Intercept/Low-Probability of Detection (LPI/LPD) ultra-wide band radios for reconnaissance and urban communications.
- Initiate development and demonstration of a Marine-portable, deployable, Tactical Jammer.

FY 2004 PLANS:

- Continue testbed effort in testing and demonstration of emerging commercial and governmental developmental C4I software and hardware.
- Complete demonstration of LPI/LPD ultra-wideband radios.
- Complete development and testing of a Marine-portable Tactical Jammer.
- Complete demonstration of a tactical signals intelligence receiver.

FY 2005 PLAN:

- Initiate over-the-horizon communications range extension demonstration.
- Initiate and complete GHz tactical communication system demonstration.
- Initiate demonstration of advanced middleware for system interoperability.
- Continue testbed effort in testing and demonstration of emerging commercial and governmental developmental software and hardware.
- Demonstrate solid-state, high-density data storage device.

	FY 02	FY 03	FY 04	FY 05
Maneuver	3,521	1,605	1,253	1,700

This activity demonstrates technologies to enhance battlespace mobility and develops an advanced vehicle technology testbed.

FY 2002 ACCOMPLISHMENTS:

- Continued testing and demonstration of light vehicle electric drive mobility performance via testing with the Reconnaissance, Surveillance, and Targeting Vehicle (RST-V) in the field.
- Demonstrated advanced tactical vehicle survivability technologies via testing with the RST-V in the field.
- Developed a Concept Validation Model (CVM) for the Tactical Unmanned Ground Vehicle (UGV) program to help develop and refine system performance specification.
- Awarded four preliminary design efforts for the Tactical UGV program.
- Completed UGV threat assessment and vulnerability study.

FY 2003 PLANS:

- Initiate analyses and limited tests of several individual structural armor materials and countermeasure technologies in support of Marine Corps Air Ground Task Force (MAGTF) Expeditionary Family of Fighting Vehicles (MEFFV) to determine effect on maneuver and survivability.

FY 2004 PLANS:

- Initiate the demonstration of essential combat system technologies, such as materials, propulsion, defensive suites, and lethality systems in support of MEFFV maneuver and survivability improvements.
- Initiate MEFFV platform design concepts.

FY 2005 PLANS:

- Initiate analyses of maneuver and survivability technologies for demonstration on a technology demonstrator testbed.
- Continue with demonstrations of key maneuver components, subsystem, and system breadboards to support initial MEFFV system design studies and trade-offs.
- Continue to develop and evaluate MEFFV platform design concepts and mission variants.

	FY 02	FY 03	FY 04	FY 05
Logistics	3,001	2,362	1,853	2,559

This activity supports Expeditionary Maneuver Warfare capabilities assessing technologies that enhance logistics flow focusing on sensors, and autonomic logistics.

FY 2002 ACCOMPLISHMENTS:

- Completed exploration of Expeditionary packaging technologies for improved distribution/throughput of sustainment items for Sea Based Logistics.
- Continued development of the Light Weight Water Purifier to meet USMC requirements – man portable, High Mobility Multi-purpose Wheeled Vehicle (HMMWV) transportable.
- Initiated Expeditionary Energy Program that includes lightweight power generation and alternative power sources focusing on man-portable energy solutions.

FY 2003 PLANS:

- Initiate Individual on the move tactical water purification/generation and distribution program.
- Continue Expeditionary Energy Program to include lightweight power generation and alternative power sources.

FY 2004 PLANS:

- Continue development and demonstration of the various technologies in the water generation and distribution program for selection.
- Continue Expeditionary Energy Program down selecting the most promising lightweight power generation technologies.

FY 2005 PLANS:

- Continue development and demonstration of the various technologies in the water generation and distribution program for selection.
- Continue Expeditionary Energy Program development of lightweight power generation technologies.

	FY 02	FY 03	FY 04	FY 05
Training & Education	1,258	2,000	2,507	3,500

This activity demonstrates the enhanced neural and cognitive aspects of human performance including portable synthetic environment generation.

FY 2002 ACCOMPLISHMENTS:

- Completed test and evaluation of Ground Combat Element (GCE) Family of Tactical Decision Making Simulations (TDS) Close Combat Marines (CCM) for use in the Staff Sergeant’s Course at the Marine Corps Institute (MCI).
- Completed test and evaluation of GCE TDS Marine Air/Ground Task Force – XXI (MAGTF-XXI) for use in the Captain’s Course at the Expeditionary Warfare School (EWS).

FY 2003 PLANS:

- Complete integration of GCE TDS Close Combat Marines in use for the Staff Sergeant's Course at the MCI. Preliminary Training Effectiveness Evaluation will be completed.
- Planned integration of GCE TDS Marine Air/Ground Task Force – XXI (MAGTF-XXI) in use for the Captain's Course at the EWS. Preliminary Training Effectiveness Evaluation will be completed.
- Initiate test and evaluation of a prototype Rapid Portable Synthetic Environment Generation capability.
- Initiate test and evaluation of a prototype for Combating Terrorism (CbT) TDS for use by the 4th Marine Expeditionary Battalion (MEB).

FY 2004 PLANS:

- Initiate test and evaluation of prototype for Combat Services Support Element (CSSE) TDS for use in the Logistics Officer's Course at the Logistics School.
- Continue test and evaluation of technology prototypes developed for a Portable Synthetic Environment Generation capability.
- Initiate test and evaluation of technology prototypes developed for instrumentation and enhanced situational awareness in a Military Operations in Urban Terrain (MOUT) training environment.
- Initiate test and evaluation of a prototype for a Combat Engineers TDS for use in the Engineer Officer's Course.
- Continue test and evaluation of a Combating Terrorism (CbT) TDS for use by the 4th Marine Expeditionary Battalion (MEB).

FY 2005 PLANS:

- Initiate integration of CSSE TDS in use for the Logistics Officer's Course at the Logistics School at Camp Johnson.
- Continue testing and evaluation of technology prototypes developed for a Rapid Portable Synthetic Environment Generation capability.
- Continue testing, evaluation, and refinement of technology prototypes developed for instrumentation and enhanced situational awareness in a MOUT training environment.
- Initiate test and evaluation of technology prototypes developed for a Training Mission Support Center (TMSC)
- Initiate testing and evaluation of technology prototypes developed for Augmented Cognition/Enhanced Human Performance (Aug Cog) applied research in the areas of human perception, memory, attention, focus and other neural warfighting attributes.
- Complete test and evaluation of a CbT TDS for use by the 4th Marine Expeditionary Battalion (MEB).

	FY 02	FY 03	FY 04	FY 05
Firepower	2,162	1,000	1,000	2,104

This activity demonstrates enhanced lethality through technological improvements in fuzes and targeting.

FY 2002 ACCOMPLISHMENTS:

- Continued development of air bursting munitions and weapon reliability of the Objective Crew Served Weapon (OCSW) with Joint Services Small Arms Program (JSSAP).

FY 2003 PLANS:

- Initiate study of insensitive fuse technologies to improve storage safety aboard shipping in support of High Mobility Artillery Rocket System (HIMARS).
- Complete development of air bursting munitions and weapon reliability of the OCSW.

FY 2004 PLANS:

- Complete study of insensitive fuse technologies for HIMARS.
- Initiate development of insensitive fuse technologies for HIMARS.

FY 2005 PLANS:

- Initiate advanced development of a micro-electro-mechanical system (MEMS) technology based target information system (TIS) in order to enhance firepower effects at ranges from near contact to 1-2 kilometers.
- Continue development of insensitive fuse technologies for HIMARS for demonstration.

	FY 02	FY 03	FY 04	FY 05
Mine Countermeasures (MCM)	1,300	1,600	1,479	2,600

This activity focuses on advanced development and demonstration of mine countermeasure technologies enabling MCM capabilities in synchronization and speed of mine detection, organic neutralization, assault breaching, tactical clearance, proofing, marking and C4I operations.

FY 2002 ACCOMPLISHMENTS:

- The Advanced Mine Detector Program (AMD) successfully demonstrated the S&T exit phase criteria.
- Completed Mine Countermeasures for Beach Exit Zone to Objectives Study identifying, quantifying and prioritizing MCM requirements, capabilities and deficiencies for naval expeditionary Forces.
- Initiated a three year modeling and simulation study with Duke University to predict performance in various environmental conditions of the Handheld standoff Mine Detection System (HSTAMIDS) and the Advanced Mine Detector.
- Initiated and completed a study of the effects of Nuclear Quadrupole Resonance (NQR) energy on magnetically fused mines.

FY 2003 PLANS:

- Initiate and complete NQR studies to increase signal amplification.
- Integrate the Handheld Standoff Mine Detection (HSTAMIDS) sensors (metal detector and ground penetrating radar) with the AMD programs' NQR sensor.
- Commence User evaluation of the AMD advanced test article (first prototype).
- Conduct independent analysis and data collection on the results of TNT, RDX, Tetryl and other explosive detection testing.
- Initiate evaluation of technologies relating to speed of detection (Stand-Off and Close-In), organic neutralization, assault breaching, tactical clearance, proofing, marking, and Command, Control, Communications, Computer and Intelligence (C4I) operations. Examples of potential efforts include the following: (1) Passive electromagnetic (EM) technologies to detect infrared (IR), millimeter wave, and microwave emissions. (2) Active EM technologies to include gamma ray imaging, x-ray backscatter, microwave enhanced IR, Radar, and magnetic induction. (3) Acoustic/seismic technologies to include active and passive acoustics, and high frequency seismic waves. (4) Mechanical displacement, explosives, and robotic technologies. (5) Mechanical and erosion mine and overburden removal, explosives, hydro/air-jet, slow burn, hyper-thermal, vibration, and robotic technologies. (6) Visual, chemical, active EM (including radioactive), film imaging, magnetic induction, acoustic/seismic interrogation, robotic, and change detection technologies.

FY 2004 PLANS:

- Begin building AMD system prototypes and initiate user evaluation and field testing.
- Continue independent analysis and data collection on the results of TNT, RDX, Tetryl and other explosive detection testing.
- Continue efforts to examine speed of detection (Stand-Off and Close-In), organic neutralization, assault breaching, tactical clearance, proofing, marking, and C4I operations.
- Investigate adaptation of US Army special clearance devices to amphibious vehicles and perform test and analyses of capability and utility.
- Evaluate sensor field systems to accurately geo-locate and provide accurate information on threat force mining activity.

FY 2005 PLANS:

- Continue user evaluation and field testing of the AMD.
- Continue independent analysis and data collection on the results of TNT, RDX, Tetryl and other explosive detection testing.
- Transition the AMD prototype to Engineering Development (6.5).

- Continue with the identification of detection (Stand-Off and Close-In), organic neutralization, assault breaching, tactical clearance, proofing, marking, and C4I operations projects for transition to 6.4 Demonstration and Validation projects.

	FY 02	FY 03	FY 04	FY 05
Littoral Combat/Power Projection (LC/PP)	6,000	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 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 functions of warfighting functions: Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), fires, maneuver, sustainment, and force protection.

FY 2002 ACCOMPLISHMENTS:

- Completed program planning to include the development of Enabling Capabilities, Technology Products, Metrics, Exit Criteria, Technology Risk, and Demonstration planning. Identified and funded technologies that can be demonstrated to specific exit criteria to transition to acquisition.
- Completed Expeditionary Maneuver Warfare (EMW) war-game to determine critical capability gaps that are particularly well suited to be resolved by innovative science and technology solutions in support of the new USMC capstone concept.
- Initiated Expeditionary Fires Technology Program to develop a prototype system with self-contained survey, networked, real-time geospatial fire control, communications and automatic aiming subsystems.

FY 2003 PLANS:

- Initiate the development of advanced Expeditionary Fires technologies to include advanced pointing and aiming system, and advanced version of the North Atlantic Treaty Organization (NATO) ballistic kernel for ballistic prediction.
- Initiate the development and flight testing of tactical unmanned vertical take-off and landing platform technologies for USMC Tier II Unmanned Air Vehicle demonstrator.
- Develop and test software segment to aid in Marine Expeditionary Unit (MEU) planning and execution of Ship to Shore Maneuver (STOM).
- Demonstrate secure wireless network capabilities and transition to acquisition.

- Continued Expeditionary Fires Technology Program to develop a prototype system with self-contained survey, networked, real-time geospatial fire control, communications and automatic aiming subsystems.

FY 2004 PLANS:

- Demonstration of prototype expeditionary fires system with stabilization technologies, advanced pointing and aiming system, and advanced ballistic prediction capability.
- Begin flight certification and shipboard integration process for a tactical unmanned vertical take-off and landing platform. Begin development of sensor packages for the air platform.
- Develop, integrate and test additional functionality for STOM planning software.
- Initiate development of Beyond Line of Sight (BLOS) tactical communications connectivity for maneuver forces.
- Continued Expeditionary Fires Technology Program to develop a prototype system with self-contained survey, networked, real-time geospatial fire control, communications and automatic aiming subsystems.

FY 2005 PLANS:

- Transition expeditionary fires technologies for inclusion in Expeditionary Fires Support System (EFSS) and Lt Wt 155 Howitzer acquisition programs.
- Transition tactical unmanned vertical take off and landing platform and sensors to acquisition.
- Evaluate STOM planning and evaluation software during a scheduled training exercise.
- Continue development of BLOS tactical communications connectivity.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0603635M Marine Corps Ground Combat/Supporting Arms Systems
PE 0206623M (Marine Corps Ground Combat/Supporting Arms Systems)
PE 0305204N (Tactical Unmanned Air Vehicles)
PE 0601152N (In-House Laboratory Independent Research)
PE 0601153N (Defense Research Sciences)
PE 0204163N (Fleet Communications - (Tactical))
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 0602131M (Marine Corps Landing Force Technology)
PE 0603612M (Marine Corps Mine/Countermeasures Systems)
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 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 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY:3 PROGRAM ELEMENT: 0603640M Project Number: R2362
PROGRAM TITLE: Marine Corps Advanced Technology Demonstrations Project Title: ELB

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2362 Extending the Littoral Battlespace (ELB)	666	930						

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Extending the Littoral Battlespace (ELB) Advanced Concept Technology Demonstration (ACTD) effort 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 02	FY 03	FY 04	FY 05
Extending the Littoral Battlespace (ELB)	666	930	0	0

The Extending the Littoral Battlespace (ELB) Advanced Concept Technology Demonstration (ACTD) effort 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 as a five year ACTD by Deputy Under Secretary of Defense (Acquisition and Technology) (DUSD (AT)) on 16 January 1997. The demonstration phase of this

effort will continue as JTF Warnet beginning in FY04. USMC transition initiatives are part of the Littoral Combat/Power Projection Future Naval Capability (LC/PP FNC)

FY 2002 ACCOMPLISHMENTS:

- Implemented multiple initiatives within Wireless LAN/Secure Wireless LAN technologies in which these technologies have demonstrated military utility. Established the service technical infrastructure to support the insertion of the technologies into USMC Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) architectures, through the integration into C4ISR test beds.

FY 2003 PLANS:

- Continue the transition of demonstrated technologies, hardware, software, and processes to Marine Corps acquisition communities. Continue support for service test beds for integration of demonstrated technologies and technical infrastructure.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0206313M Marine Corps Communications Sys

NON-NAVY RELATED RDT&E:
NA

D. ACQUISITION STRATEGY: Not Applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY:3 PROGRAM ELEMENT: 0603640M Project Number: Various
PROGRAM TITLE: Marine Corps Advanced Technology Demonstrations Project Title: Congressional Plus-ups

Congressional Plus-Ups:

C2297	FY 02	FY 03
Project Albert	*	*

* Described in C2297 Project

C2297	FY 02	FY 03
Mobile Counter-Fire System (MCFS)	*	*

* Described in C2297 Project

C2297	FY 02	FY 03
Advanced Light Strike Vehicle (ALSV)	0	*

* Described in C2297 Project

C9154	FY 02	FY 03
Center for Emerging Threats and Opportunities CETO)	0	962

CETO is a partnership between the Marine Corps Warfighting Laboratory (MCWL) and the Potomac Institute for Policy Studies (PIPS). CETO's mission is to identify emerging threats, explore concepts, and determine capabilities and solutions to meet future challenges in coordination with the United States Marine Corps (USMC) operating forces. CETO coordinates its work with the operating forces and makes its recommendations to the Commanding General, MCWL regarding emerging capabilities that are candidates for transition to the Expeditionary Force Development System. In addition CETO has recently been tasked to support senior USMC leadership on a wide array of issues.

C9154	FY 02	FY 03
Rapid Deployment Fortification Wall	0	1,010

The purpose of this Improved Expedient Fortification Construction program is to experiment with commercial-off-the-shelf expedient fortification construction systems. Currently the expedient fortification technique is manpower intensive and a one-time-usage, sandbag construction method. Based on the rapidly changing asymmetric environment that our Marines operate in, the need to provide an easy to build, scalable, and re-usable force protection structure is critical. By leveraging modern materials and techniques, the Marine Corps can increase force protection while decreasing the manpower

hours needed to construct expedient fortifications. Efforts will entail investigation and experimentation with new technologies, techniques, and procedures (TTPs).

C9154	FY 02	FY 03
Transportable Transponder Landing System (TTLS)	0	2,163

TTLS was originally developed under a Defense Advanced Research Projects Agency (DARPA) effort through Naval Air Systems Command (NAVAIR) and Advanced Navigation and Positioning Corp (ANPC). The system was designed to provide a precision approach capability by using inexpensive ground systems to provide position information for aircraft equipped with a transponder and standard Federal Aviation Administration (FAA) Category I Instrument Landing System (ILS) equipment. In order for TTLS to suit the USMC tactical mission requirements, several technologies must be developed. These include: Link 4A data-link guidance output to support USMC aircraft; multiple aircraft tracking and guidance; miniaturization of the system for mounting on a supporting ground vehicle; reciprocal approaches/runway support; Local Sector Surveillance & Control; and reduced TTLS susceptibility to jamming. Efforts will entail investigating technology developments.

R2995	FY 02	FY 03
California Central Coast Research Partnership (C3RP) Initiative	1,249	3,027

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 will continue to explore this potential and to identify and support relevant research and expertise. Completed the definition of core excellence area in information system/network bandwidth development as a national resource for the use of government, academia, and the private sector.

R9028	FY 02	FY 03
Marine Corps Future Logistics	1,637	N/A

Expeditionary Energy program addresses the continuum of mobile power to include all aspects from generation to consumption. These efforts develop new capabilities to reduce logistics footprint ashore. This effort provides technical analysis of lightweight generators, alternative power sources, and on-board vehicle power generation. This effort culminated with the development of three proof of concept systems.

R9029	FY 02	FY 03
Fast Refueling System	1,649	N/A

Provided for operational testing and evaluation, modifications, and purchase of the fast refueling system. FAST is a means to package fuel into configurations that allow emergent fuel re-supply under expeditionary forward operating

conditions. The FAST program goal is to initiate design, development, and evaluation of flexible liquid container configurations to support high portability/transport and rapid employment. Technical objectives involve the examination of industrial polymer composites and high strength filament windings derived from carbon filament, kevlar, polyester yarn, fiberglass, neoprene, and synthetic rubbers to provide high reliability, durability and significantly reduced life cycle costs. Field User Test and Evaluation of the FAST system validated needed modifications to the system and refined concepts of employment. Initiated development of technology transition plans for FRS system.

R9290	FY 02	FY 03
Expeditionary Unit Water Purification Technology	N/A	6,148

Expeditionary Unit Water Purification program addresses large capacity water production capabilities in the 100K-500K gallons per day range. These efforts will focus on developing new technologies that will reduce logistics footprint making these large scale systems much more expeditionary. This effort is targeted to provide a C130 transportable system. This effort culminates with the development of a proof of concept system.

R9167	FY 02	FY 03
Man-Portable Quadrupole Resonance	0	*

(*$2,445 was appropriated in FY 2003 PE 0603792N)

This activity focuses on advanced development and demonstration of landmine countermeasures technologies; specifically, a landmine detection system on quadrupole resonance technology, engineered into a man-portable configuration.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603706N
PROGRAM ELEMENT TITLE: MEDICAL DEVELOPMENT

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE
R2333 Rural Health	6,532	
R2334 Bone Marrow	27,825	
R2492 Medical Readiness Telemedicine Initiative	7,397	
R2714 Teleradiology	961	
R2834 Robot Eyes	2,401	
R2836 Vector Vaccine	961	
R9000 Nursing Telehealth Applications	2,501	
R9001 Mobile Integ Diagnost & Data	963	
R9002 Minimally Invasion Surgical Technology	961	
R9003 Biomed Research Imaging Core-CoH Nat Med Ctr	3,843	
R9004 Portable Prod Of Sterile Water For Intravenous	961	
R9005 Community Hospital Telehealth Consortium	1,442	
TOTAL	56,748	

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603706N
PROGRAM ELEMENT TITLE: MEDICAL DEVELOPMENT

This PE was restructured in FY 2002. FY2003 Congressional Plus-ups appropriated in this PE are described under the following restructured program elements:

Title	RESTRUCTURED PROGRAM ELEMENT	FY 2002	FY 2003
Biomed Research Imaging Core-CoH Nat Med Ctr	0603729N	3,843	
Bone Marrow	0603729N	27,825	
Community Hospital Telehealth Consortium	0603729N	1,442	
Medical Readiness Telemedicine Initiative	0603729N	7,397	
Minimally Invasion Surgical Technology	0603729N	961	
Mobile Integ Diagnost and Data	0603729N	963	
Nursing Telehealth Applications	0603729N	2,501	
Portable Prod of Sterile Water for Intravenous	0603729N	961	
Robot Eyes	0603729N	2,401	
Rural Health	0603729N	6,532	
Teleradiology	0603729N	961	
Vector Vaccine	0603729N	961	

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603707N
PROGRAM ELEMENT TITLE: MANPOWER, PERSONNEL AND TRAINING ADV TECH DEV

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE
R2739 RIT Center for Integrated Manufacturing	1,921	0
TOTAL	1,921	0

This PE was restructured in FY 2002.

Congressional Plus-ups appropriated in this PE are described under the following restructured program elements:

Title	Restructured Program Element	FY 2002	FY 2003
RIT Center For Integrated Manufacturing	0603236N	1,921	0

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603712N
PROGRAM ELEMENT TITLE: Environmental Quality & Logistics Advanced Technology

(U) COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE
R9006 Sustainable Readiness Center	1,348	0
R9160 Real-Time Infra Red Scene Generator	0	977
TOTAL	1,348	977

This PE was restructured in FY 2002. FY 2003 Congressional Plus-ups appropriated in this PE are described under the following restructured program elements:

Title	RESTRUCTURED PROGRAM ELEMENT	FY 2002	FY 2003
Sustainable Readiness Center	0603236N	$1,348	
Real-Time Infra Red Scene Generator	0602114N		$977

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: Joint Experimentation

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2497 Joint Experimentation								
Total	99,996	95,512	151,058	162,105	169,350	166,838	157,040	158,192

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Combatant Commander, U.S. Joint Forces Command (C/C USJFCOM) is chartered "as the Executive Agent for conducting joint warfighting concept development and experimentation within the Department of Defense. This effort enables C/C JFCOM to explore new joint warfighting concepts and capabilities and determine Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities, (DOTMLPF) implications for change." The Secretary of Defense signed the U.S. Joint Forces Command's Joint Warfighting Experimentation Charter on 15 May 1998. Joint Experimentation implements this transformation mission through a process of discovery, innovation, concept development, and experimentation to provide for optimal joint future force capability. Our goal is to develop the joint context in which joint and service concept development and experimentation can prosper. The Services determine the specific Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities, (DOTMLPF) requirements for their core competencies supporting the joint context. Each Combatant Commander (C/C) has input to the priorities for experimentation through the U.S. Joint Forces Command Combatant Commander Engagement program.

U.S. Joint Forces Command's (USJFCOM) efforts over the next several years will focus in particular on two overarching concepts: improving joint Knowledge/Command and Control (K/C2) through such initiatives as exporting the Standing Joint Force Headquarters (SJFHQ) concept to the regional Combatant Commanders, and conducting more effective joint operations through refining Rapid Decisive Operations—Next Decade and Joint Capstone Concept. USJFCOM concept that the Standing Joint Force Headquarters (SJFHQ) be embedded in the various Combatant Commander's (C/C) staffs under the direction of a flag or general officer is generally accepted. When a contingency requires the establishment of a Joint Task Force (JTF), the Combatant Commander's Standing Joint Force Headquarters (SJFHQ) can immediately become the collaborative core of the Joint Task Force (JTF). USJFCOM developed the Standing Joint Force Headquarters (SJFHQ) concept around approximately fifty-five personnel. This experimental SJFHQ explores the concept and alternative organizational arrangements, to provide a test bed for innovation with new technologies and operational approaches for joint Command and Control. U.S. Joint Forces Command's (USJFCOM) Experimental Standing Joint Command and Control Element (ESJC2E) works closely with designated Joint Task Force (JTF) headquarters established by regional Unified Commands under direction of the Secretary of Defense (SECDEF). Services will develop interoperable command and control capabilities for functional components based on joint context. Developing new approaches for the Standing Joint Force Headquarters (SJFHQ) addresses the first two of four transformation pillars identified in the Quadrennial Defense Review (noted below), and meets specific guidance from the Secretary of Defense and the Chairman Joint Chiefs of Staff.

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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: Joint Experimentation

The four Transformation Pillars from the Quadrennial Defense Review are as follows: (1) Strengthen joint operations through standing joint task force headquarters, improved joint command and control, joint training and an expanded joint forces presence policy; (2) Experimenting with new approaches to warfare, operational concepts and capabilities, and organizational constructs such as standing joint forces through wargaming, simulations and field exercises focused on emerging challenges and opportunities; (3) Exploiting U.S. intelligence advantages through multiple intelligence collection assets, global surveillance and reconnaissance, and enhanced exploitation and dissemination; and (4) Developing transformational capabilities through increased and wide-ranging science and technology, selective increases in procurement, and innovations in DoD processes. Developing new concepts for establishing and operating the Standing Joint Force Headquarters (SJFHQ) was central to the improvement of future joint operations, and will be a continued central focus of Joint Concept Development & Experimentation for at least the next several years.

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

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	102,868	97,872	106,500	66,029
Adjustments from FY 2003 President's Budget:				
SBIR	-2,366			
S&T Reductions			-7,255	-4,629
Cong. Rescissions/Adjustments/Undist. Reductions	-506	-1,118		
FY03 FFRDC Reduction		-206		
Joint Program Increases			+28,200	+63,000
Training Transformation			+27,100	+41,200
Pay Raise/Inflation Adjustments		-1,036	-3,487	-3,495
FY 2004/2005 President's Budget Submission:	99,996	95,512	151,058	162,105

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603727N Project Number: R2497
PROGRAM ELEMENT TITLE: Joint Experimentation Project Title: Joint Experimentation

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2497 Joint Experimentation								
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A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Combatant Commander, U.S. Joint Forces Command (C/C USJFCOM) is chartered "as the Executive Agent for conducting joint warfighting concept development and experimentation within the Department of Defense. This effort enables C/C JFCOM to explore new joint warfighting concepts and capabilities and determine Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities, (DOTMLPF) implications for change." The Secretary of Defense signed the U.S. Joint Forces Command's Joint Warfighting Experimentation Charter on 15 May 1998. Joint Experimentation implements this transformation mission through a process of discovery, innovation, concept development, and experimentation to provide for optimal joint future force capability. Our goal is to develop the joint context in which joint and service concept development and experimentation can prosper. The Services determine the specific Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities, (DOTMLPF) requirements for their core competencies supporting the joint context. 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. Within that area of responsibility, we examine ways to enhance the current force, to actualize the Joint Vision 2020, and to dominate the revolution in military affairs. 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. This common joint context has not historically existed, but it 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.

Recommended changes resulting from experimentation are forwarded to the Chairman, Joint Chiefs of Staff and the Joint Requirements Oversight Council (JROC) for implementation. Individual Military Services and United States Special Operations Command (USSOCOM) retain primary responsibility to develop concepts and conduct experimentation within their core competencies, to include their land, air and space, sea, expeditionary and special operations roles. U.S. Joint Forces Command (USJFCOM) serves as the joint force integrator. The Assistant Secretary of Defense for Strategy and Threat Reduction (ASD (S&TR)) monitors U.S. Joint Forces Command's (USJFCOM) joint concept experimentation activities on behalf of the Secretary of Defense. Having an oversight role in the Revolution in Military Affairs (RMA), Assistant Secretary of Defense Strategy and Threat Reduction ASD (S&TR) conducts reviews of C/C JFCOM experimentation activities.

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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603727N Project Number: R2497
PROGRAM ELEMENT TITLE: Joint Experimentation Project Title: Joint Experimentation

U.S. Joint Forces Command serves two major roles in advancing joint warfighting capabilities. These are documented in the following:

- DODI 5000.2-R, June 2001, Mandatory Procedures for Major Defense Acquisition Programs, C7.3.1. "United States Joint Forces Command shall be available to comment on interoperability and integration issues that the JROC [sic. Joint Requirements Oversight Council] forwards to the DAB [sic. Defense Acquisition Board]."
- CJCSI 3170.01B, 15 April 2001, Requirements Generation System, B2.d.7.b. "C/CJFCOM will serve as the Chairman's advocate for joint warfighting interoperability. USJFCOM [sic. U.S. Joint Forces Command] will provide the warfighter perspective during the development of joint operational concepts to ensure that joint forces have interoperable systems."

The Joint Experimentation Campaign Plans focus on high priority tasks assigned to U.S. Joint Forces Command 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 U.S. Joint Forces Command 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). Two proposals entering concept refinement are Joint Operations Warfighting (JOW) and Time Sensitive Targeting (TST). Refinement of these concepts and other emerging concepts are based on lessons learned from completed FY 2001 and FY 2002 joint experimentation activities.

In FY 2002 and 2003, U.S. Joint Forces Command continues a series of risk mitigation experiments and Limited Objective Experiments (LOEs) while conducting our first major joint field experiment Millennium Challenge 2002. Planning was accelerated for the Impact/Vision Experiments as a continuous experimentation pathway in addition to the prototype pathway for Standing Joint Force Headquarters (SJFHQ) enabling concepts. A series of experiments address the challenges of Rapid Decisive Operations -- Next Decade and Joint Capstone Concept (JCC) to integrate concepts in FY 2015 and beyond. Millennium Challenge 2002 (MC02) explored a coherent joint force capable of conducting a rapid, decisive joint strike operation in the 2004-2009 timeframe. Impact/Vision Experiment series will explore Rapid Decisive Operations (RDO) – Next Decade in the 2015-2020 timeframe. The Impact and Vision series of joint 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. U.S. Joint Forces Command continuously coordinates with all the Combatant Commander's, the Joint Staff, and Services in the concept development and experimentation on the Vision and Impact series and the execution of concepts including the integration of our multinational coalition partners and other U.S. agencies referred to as Inter-Agency (IA) information sharing.

In the Campaign Plan 2003, the Combatant Commander of Joint Forces Command 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. U.S. Joint Forces Command synchronized Joint and Service efforts in a "battle rhythm" that balances

concept development with experimentation, and field events requiring advanced preparation with smaller events that are more agile and adaptable. U.S. Joint Forces Command (USJFCOM) continues to strengthen these tools for conducting joint concept development and experimentation, including scalable parallel modeling and simulation, providing highly capable and thinking adversaries through more effective red teaming initiatives, and stronger building links with other U.S. agencies and potential coalition partners.

U.S. Joint Forces Command (USJFCOM) conducted a series of experimental efforts to evaluate and analyze concepts against a realistic or live scenario. These efforts consist of major joint field experiments, major joint simulated experiments, Limited Objective Experiments (LOEs), wargames and seminars. Millennium Challenge 2002 was the major experimental focus of FY 2002. Other efforts are continuing on a second track separate from Millennium Challenge 2002 to accelerate or continue the development of concepts such as Forcible Entry Operations (FEO), Effects Based Operations (EBO), Assured Access (AA), Joint Intelligence Surveillance and Reconnaissance (JISR), Joint Urban Operations (JUO), Low Collateral Damage Weapons (LCDW), and Time Sensitive Targets (TSTs), Focused Logistics (FL), Strategic Deployment (SD), Joint Operational Warfighting (JOW), and Information Operations (IO) among others.

The terrorist attacks on the U.S. homeland in September 2001 and the U.S. and allied response in Afghanistan underscored the new challenges that U.S. forces will face in coping with the threat of terrorism. U.S. Joint Forces Command's (USJFCOM) Joint Concept Development and Experimentation (JCD&E) effort is an indispensable component to improving U.S. capabilities to conduct war as well as a war on terrorism. These wars cannot be won solely with legacy systems or thinking. Development of advanced techniques, tools, and organizations to defeat an asymmetrical enemy terrorist and meet other new challenges of the 21st century, requires new thinking and aggressive experimentation to ensure the effectiveness of the future joint force.

U.S. Joint Forces Command's (USJFCOM) efforts over the next several years will focus in particular on two overarching concepts: improving joint Knowledge/Command and Control (K/C2) through such initiatives as exporting the Standing Joint Force Headquarters (SJFHQ) concept to the regional Combatant Commanders, and conducting more effective joint operations through refining Rapid Decisive Operations—Next Decade and Joint Capstone Concept. USJFCOM concept that the Standing Joint Force Headquarters (SJFHQ) be embedded in the various Combatant Commander's (C/C) staffs under the direction of a flag or general officer is generally accepted. When a contingency requires the establishment of a Joint Task Force (JTF), the Combatant Commander's Standing Joint Force Headquarters (SJFHQ) can immediately become the collaborative core of the Joint Task Force (JTF). USJFCOM developed the Standing Joint Force Headquarters (SJFHQ) concept around approximately fifty-five personnel. This experimental SJFHQ explores the concept and alternative organizational arrangements, to provide a test bed for innovation with new technologies and operational approaches for joint Command and Control. U.S. Joint Forces Command's (USJFCOM) Experimental Standing Joint Command and Control Element (ESJC2E) works closely with designated Joint Task Force (JTF) headquarters established by regional Unified Commands under direction of the Secretary of Defense (SECDEF). Services will develop interoperable command and control capabilities for functional components based on joint context. Developing new approaches for the Standing Joint Force Headquarters (SJFHQ) addresses the first two of four transformation pillars identified in the Quadrennial Defense Review (noted below), and meets specific guidance from the Secretary of Defense and the Chairman Joint Chiefs of Staff.

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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603727N Project Number: R2497
PROGRAM ELEMENT TITLE: Joint Experimentation Project Title: Joint Experimentation

The four Transformation Pillars from the Quadrennial Defense Review are as follows: (1) Strengthen joint operations through standing joint task force headquarters, improved joint command and control, joint training and an expanded joint forces presence policy; (2) Experimenting with new approaches to warfare, operational concepts and capabilities, and organizational constructs such as standing joint forces through wargaming, simulations and field exercises focused on emerging challenges and opportunities; (3) Exploiting U.S. intelligence advantages through multiple intelligence collection assets, global surveillance and reconnaissance, and enhanced exploitation and dissemination; and (4) Developing transformational capabilities through increased and wide-ranging science and technology, selective increases in procurement, and innovations in DoD processes. Developing new concepts for establishing and operating the Standing Joint Force Headquarters (SJFHQ) was central to the improvement of future joint operations, and will be a continued central focus of Joint Concept Development & Experimentation for at least the next several years.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Rapid Decisive Operations – Next Decade	7,036	9,782	0	0

FY 2002 ACCOMPLISHMENTS:

- Continued exploration and refinement of the Rapid Decisive Operations concept through the execution of various Limited Objective Experiments (Operational Net Assessment, Focused Logistics, Multi-National, and Effects Tasking Order-to-Action), and the Millennium Challenge 2002 (MC02) experiment in July-August 2002.
- The Limited Objective Experiments (LOE) and the Millennium Challenge 2002 experiment assessed the "how" of the concept. These LOEs included:

- Effects Tasking Orders (ETO)-to-Action. Experimented on how these orders are issued and prepared in a collaborative environment with the Common Relevant Operational Picture (CROP).
- Operational Net Assessment (ONA) addressed how we accurately do Operational Net Assessment a continuously updated system-of-systems analysis of the adversary's total war-making capabilities. Its purpose was to identify key links and nodes within the adversary's systems, propose methods that will influence, neutralize or destroy them and achieve a desired effect or outcome. Operational Net Assessment clearly identified the need for a more integrated approach relying on all national agency assets (e.g. State Department, Federal Emergency Management Agency, National Security Agency, etc.) to operationalize knowledge in response to threats and targets.
- Peer-to-Peer explored information sharing between computers and wireless equipment for military application.

FY 2003 PLANS:

- U.S. Joint Forces Command continues to refine the Rapid Decisive Operations—Next Decade concept through the execution of various Impact and Vision Experiments. Vision/Impact experiments will examine the capabilities of

the joint force in the 2010-2020 timeframe against a projected capable regional threat, in a small-scale contingency, to determine how the joint force will execute Rapid Decisive Operations in the next decade. The continuous experimentation program at Joint Forces Command prepares the way for emerging concepts and Technologies to enter and progress through the experimentation cycle rapidly in response to Joint Warfighter needs.

- USJFCOM continues the Chairman Joint Chief of Staff's (CJCS) direction to achieve an operable Standing Joint Force Headquarters (SJFHQ) by 2005 for each of our Combatant Commanders. "Our objectives are clear: to ensure U.S. military superiority into the 21st century; reduce the risk of adversarial surprise; better inform current decision-makers concerning future forces; and achieve wartime levels of learning through experimentation in peacetime, with no cost to life, limb or the national interest. Synchronizing the concept development and experimentation efforts of the joint community and the Services, it provides the joint context and structure necessary for complex field events while also providing the flexibility necessary to adapt quickly to new challenges and opportunities."

FY 2004 PLANS:

- Not applicable

FY 2005 PLANS:

- Not applicable

	FY 02	FY 03	FY 04	FY 05
Millennium Challenge	55,868	0	0	0

FY 2002 ACCOMPLISHMENTS:

- Millennium Challenge 2002 experiment executed July through August 2002. It was a major joint integrating experiment that was the culminating point for assessing how we performed a Rapid, Decisive Operation in this decade and determined the extent to which the joint force is able to implement the principles of Joint Vision 2020. The experiment encompassed both live and virtual forces, including elements from all military services and special operations. Given the capabilities of the joint force and a major regional threat in the 2009 period, the Millennium Challenge 2002 experiment determined the extent to which we can set the following operational conditions for Rapid Decisive Operations such as establishing a knowledge network.
- Established Joint Knowledge/Command and Control (K/C2) functions including: Joint Intelligence, Surveillance and Reconnaissance (JISR) capabilities; access and sustainment to a distributed, non-contiguous operation without relying on fixed bases adjacent to the objective area; full-dimensional/time-definite superiority for selected forces and actions with the battlespace; and conducting simultaneous, joint tactical actions throughout the battlespace based on a shared understanding of both the tactical and operational situation.

- Assured Access. USJFCOM continued the exploration of the Assured Access Concept through the execution of the Millennium Challenge 2002 experiment and Limited Objective Experiments. The concept explored how a Joint Force Commander can gain the requisite level of physical, spectral and cyber access to an adversary's domain.
- Standing Joint Force Headquarters (SJFHQ). Tasking initiated by the Secretary of Defenses to further develop the organizational establishment of a joint command and control aspect for a rapid decisive operation. When fully operational, this emerging command and control structure will transform the preemptive and follow-on options for a unified Combatant Commander. This will provide the Combatant Commanders with an increased range of options for crisis response within their area of responsibility. In February 2002, we moved the Standing Joint Force Headquarters from the conceptual stage to the experimental design stage. A notional Standing Joint Force Headquarters was "test driven" during the Millennium Challenge 2002. Joint experimenters observed and assessed the viability of the Standing Joint Force Headquarters and made recommendations to keep it flexible enough to support tomorrow's fighting force.

FY 2003 PLANS:

- Not Applicable

FY 2004 PLANS:

- Not Applicable

FY 2005 PLANS:

- Not Applicable

	FY 02	FY 03	FY 04	FY 05
Joint National Training Center	3,000	0	27,100	41,200

FY 2002 ACCOMPLISHMENTS:

- The Deputy Secretary of Defense (DEPSECDEF) approved the establishment of a Joint National Training Center (JNTC) as defined in the Defense Planning Guidance (DPG 04-09) to collect, merge, and validate Joint training requirements in the form of a Joint Management Office. US Joint Forces Command (JFCOM) established the Joint Management Office (JMO) to perform implementation planning and establish the JNTC for stand-up by 1 October 04.
- In conjunction with Under Secretary of Defense, JFCOM established a transition to what is now the Joint National Training Center initiative, and began building a top-level organization requiring management, operational and technological assessment strategy.
- The JNTC concept improves Defense-wide training programs to ensure that Service, agency and Joint training programs prepare warfighters to train the way they fight. The JNTC coordinates all activities required to meet Combatant Commander's requirements for Joint capable forces. It provides for full spectrum Joint training at the strategic, operational, and tactical levels of war, and coordinates the optimal mix of live, virtual and

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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603727N Project Number: R2497
PROGRAM ELEMENT TITLE: Joint Experimentation Project Title: Joint Experimentation

constructive training enablers in order to ensure a seamless and realistic Joint training environment worldwide.

FY 2003 PLANS:

- Not applicable

FY 2004 PLANS:

- The Joint National Training Center (JNTC) continues in the establishment of the Joint Management Office that merges and validates requirements, including certification and accreditation. JNTC begins to implement a capabilities improvement process based on the Joint Training System; implements a standing Joint Command and Control (JC2) headquarters capability for training; creates a realistic standing opposition force (OPFOR); provide a global Joint training infrastructure (GJTI); and develops, assesses, and deploys advanced training technologies (ATT).
- The JNTC ensures that training ranges and devices are modernized and sustainable; interoperability training is measured and reported; networked training capabilities are designed into operational systems and requirements; and distributed learning technologies are used to reengineer training and job performance. The plan for near-term Training/Transformation actions is the development of "a common operational architecture that provides interoperability of live, virtual, and constructive training systems across the Department, leading to the creation of a Joint national training capability that meets service, interoperability, and CINC training needs." (Office of the Under Secretary of Defense).

FY 2005 PLANS:

- The Joint National Training Center (JNTC) continues to advance and implement the following programs:
- Joint Training System Application (JTSA) implements a Capability Improvement Process to develop warfighter Joint Tactical Tasks (JTT) and incorporates JTTs into training events and complete training assessments. These tasks directly support operational requirement analysis and operational support of specific events.
- Joint Command and Control (JC2) uses the latest C4ISR equipment and Joint tactics, techniques, and procedures to enable the continuing development of transformational concepts for export to Service training ranges and events. These tasks will be in direct support of operational planning and implementation of JC2
- Joint Opposing Force (OPFOR) is a coherent robust adversary capability participating in Joint events. Additionally, procurements of OPFOR systems/assets support JNTC training sites and events, leveraging service and commercial capabilities. The JNTC develops and procures assets where necessary to enhance capabilities for Joint context. The opposing force includes an element to address requirements and business activities as well as a targeted headquarters and red cell for Joint training exercise execution. These tasks directly support operational planning and implementation of OPFOR functions for JNTC events.
- Global Joint Training Infrastructure (GJTI) develops, identifies, and implements architecture and standards required to enable distributed Joint training across DoD sites, simulation centers, training locations, and ranges. The GJTI function will include integration and testing of systems in preparation for specific events and capabilities and leveraging national capabilities (i.e. GIG), augmenting where necessary to ensure connectivity and capabilities required by JNTC. These tasks directly support operational planning and

implementation of JNTC infrastructure requirements. Research and Development tasks will support the analysis and development of specific JNTC infrastructure capabilities, including advances in communications, interoperability, data transfer, and range instrumentation. Procurement of Command and Control, communications, audio, visual, simulation systems, knowledge management systems, range instrumentation, etc. is essential to achieve the infrastructure objectives.

- Advanced Training Technologies (ATT) manages the incorporation of new technologies and techniques into training scenarios; it creates a test and integration test bed to validate live, virtual, and constructive training events across a distributed network. Under this function the validated technologies and systems operates in direct support of exercises. Advanced Training Technologies maintains support to JNTC sites and events. Research and development tasks provide technological improvements needed to make Joint national training more efficient and effective. Procurement for specific systems supports research and development tasks. The GJTI function procures operational systems. JNTC determines requirements and funding to Service instrumentation programs ensuring Joint functionality, interconnectivity, and interoperability of future instrumentation systems. JNTC continues to develop Joint OPFOR capabilities, leveraging Service programs, and commercial sources.

	FY 02	FY 03	FY 04	FY 05
Joint Capstone Concept (JCC) formaly known as Joint Warfighting Concept (JWC)	0	0	15,818	15,900

FY 2002 ACCOMPLISHMENTS:

- Not applicable

FY 2003 PLANS:

- Not applicable

FY 2004 PLANS:

- Joint Capstone Concept is the next integrating/overarching Concept used while refining and executing Rapid Decisive Operations and the Standing Joint Force Headquarters. U.S. Joint Forces Command will develop, experiment and refine the Joint Capstone Concept through the execution of various Impact and Vision Experiments affecting the 2010-2020 timeframe. Experiments focus against a projected capable regional threat, in a small-scale contingency, to determine how the joint force will execute Rapid Decisive Operations--Next Decade. The continuous experimentation program at Joint Forces Command prepares the way for emerging concepts and technologies to enter and progress through the experimentation cycle rapidly in response to Joint Warfighter needs. Joint Capstone Concept spawns multiple supporting concepts for refinement topics which may include Forward Basing, Strategic Lift, Robotics, etc.

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FY 2005 PLANS:

- USJFCOM continues to develop and refine the Joint Capstone Concept through the execution of various Impact and Vision Experiments affecting the 2015-2030 timeframe. The continuous experimentation program at Joint Forces Command prepares the way for emerging concepts and leading technologies. The experimentation cycle is responsive to the Joint Warfighter needs in an effort to gain Full Spectrum Dominance over the adversary.
- Full Spectrum Dominance. In the Joint Vision 2020, the overarching focus is full spectrum dominance achieved through the interdependent application of dominant maneuver, precision engagement, strategic deployment, and full dimensional protection. Attaining full spectrum dominance requires the steady infusion of new technology and modernization and replacement of equipment to transform the military.
  - Dominant Maneuver. Dominant Maneuver is the ability of joint forces to gain positional advantage with decisive speed and overwhelming operational tempo in the achievement of assigned military tasks. Widely dispersed joint air, land, sea, amphibious, special operations and space forces, capable of scaling and massing force or forces and the effects of fires as required for either combat or non-combat operations, will secure advantage across the range of military operations through the application of information, deception, engagement, mobility and counter-mobility capabilities.
  - Precision Engagement. Precision Engagement is the ability of joint forces to locate, surveil, discern, and track objectives or targets; select, organize, and use the correct systems; generate desired effects; assess results; and reengage with decisive speed and overwhelming operational tempo as required, throughout the full range of military operations.
  - Strategic Deployment. Strategic Deployment is the ability to provide the joint force the right personnel, equipment, and supplies in the right place, at the right time, and in the right quantity, across the full range of military operations. This will be made possible through a real-time, web-based information system providing total asset visibility as part of a common relevant operational picture, effectively linking the operator and logistician across Services and support agencies. Through transformational innovations to organizations and processes, strategic deployment will provide the joint warfighter with support for all functions.
  - Full Dimensional Protection. Full Dimensional Protection is the ability of the joint force to protect its personnel and other assets required to decisively execute assigned tasks. Full dimensional protection is achieved through the tailored selection and application of multi-layered active and passive measures, within the domains of air, land, sea, space, and information across the range of military operations with an acceptable level of risk.

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	FY 02	FY 03	FY 04	FY 05
Impact and Vision Experiment Series – formerly known as Olympic Challenge	7,690	41,580	41,625	35,800

FY 2002 ACCOMPLISHMENTS:

- These planning efforts explored and refined the early concepts of the joint field experiment and review post-experiment analysis of Millennium Challenge 2002 to prepare for the 2003/2004 experiments and beyond in support of the Rapid Decisive Operations-Next Decade concept. This series of experiments is about continuous development and examination of how a rapid decisive operation could be executed in the next decade during an operation that is at the high-end, small-scale contingency area on the range of operations. The Rapid Decisive Operations (RDO) -- Next Decade concept will integrate Knowledge/Command and Control (K/C2) and Effects-Based Operations (EBO) to achieve the desired political/military effect.

FY 2003 PLANS:

- This series continues to explore and refine the findings of the joint field experiment Millennium Challenge 2002, as the basis of the 2003/2004 experiments and the Rapid Decisive Operations-Next Decade concept. Prepare and execute Pinnacle Impact 2003 to begin foundational concepts and plans for Pinnacle Vision 2004 (Joint Global Wargame) while developing core elements of Joint Capstone Concepts and other Service concepts.

FY 2004 PLANS:

- This series explores and refines the findings of previous experimentation efforts, and the continuous follow-on series of experiments for both the Rapid Decisive Operations-Next Decade and Joint Capstone Concepts (JCC). Pinnacle Vision 2004 will be the Combatant Commander's Joint Global Wargame, and will execute: Rapid Decisive Operations (RDO)-Next Decade concept while using the Standing Joint Force Headquarters and integrating Knowledge/Command and Control (K/C2), Multi-national Coalitions and interoperable service involvement achieving the desired political/military effect. Joint Capstone Concept integrates a number of Concepts along with Strategic Deployment (SD), Joint Operational Warfighting (JOW), Operational Net Assessment (ONA) and others.

FY 2005 PLANS:

- USJFCOM will perform post-experiment analysis on Joint Global Wargame and will refine the findings of previous experimentation efforts and the continuous follow-on series of experiments for Joint Capstone Concepts and other Service concepts. Fielding of the Standing Joint Force Headquarters (SJFHQ) with each Combatant Commander examining the "how" of a rapid decisive operation using Effects Based Operations (EBO).

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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603727N Project Number: R2497
PROGRAM ELEMENT TITLE: Joint Experimentation Project Title: Joint Experimentation

	FY 02	FY 03	FY 04	FY 05
Knowledge Centric Command & Control (K/C2) – formerly Information Superiority	4,296	6,040	7,650	8,355

FY 2002 ACCOMPLISHMENTS:

- Continued exploration and enhancement of the four functional warfighting concepts: Common Relevant Operational Picture (CROP), Joint Interactive Planning (JIP), Adaptive Joint Command and Control (AJC2), and Information Operations (IO), through the planning and execution of Limited Objective Experiments.

FY 2003 PLANS:

- Continue exploration and enhancement of functional warfighting concepts becoming interoperable. Plan and execute workshops to refine the multi-service Distributed Common Ground Station (DCGS). This will enable the complete exploration of the concept during an LOE. This is a key component to enable the comprehensive connectivity and shared understanding to support Joint Capstone Concept. This connectivity is critical to pass DCGS information from the sensors to the shooter.

FY 2004 PLANS:

- Continue refining the functional warfighting concepts and integrated, interoperable Command and Control. Develop knowledge ties with previous Joint Intelligence Surveillance and Reconnaissance work to evaluate inter-community sensor cross cueing for optimum utilization of assets and provide sensor to shooter connectivity. Through LOEs and Impact/Vision experiments, USJFCOM will develop the Joint Force Commander’s ability to see a singular battlespace environment thus reducing the decision cycle so that he can realize the full potential of Effects Based Operations (EBO) and Dominant Maneuver operations. These improvements in K/C2 also refine the capabilities of the Standing Joint Force Headquarters. When adopting the knowledge with the command and control efforts for interoperability, these functional concepts become the baseline for Joint Operational Warfighting (JOW) approach within the Joint Capstone Concept (JCC).

FY 2005 PLANS:

- Discover new capabilities and systems of systems modifications to provide innovation and planning for future enhancements by using emerging technologies to improve the integration and interoperability of warfighting command and control and information superiority. Continue exploration, development and refinement of the knowledge/information supporting the Joint Capstone Concept and Service Concepts.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603727N Project Number: R2497
PROGRAM ELEMENT TITLE: Joint Experimentation Project Title: Joint Experimentation

	FY 02	FY 03	FY 04	FY 05
Standing Joint Force Headquarters (SJFHQ) Interoperability Technology Demonstration	0	0	10,000	13,500

FY 2002 ACCOMPLISHMENTS:

- Not Applicable.

FY 2003 PLANS:

- Not Applicable.

FY 2004 PLANS:

- Interoperability Technology Demonstration (ITDC) is a new initiative supporting JFCOM's responsibilities for Joint Command & Control capabilities. The technologies being assessed in interoperability demonstrations are controlled software processes of pilot implementations under consideration for acquisition, the purpose of which is to ensure interoperability within the joint Command and Control environment (JC2E) with the added advantage of enabling high quality cost and schedule estimates of low-support-cost-implementations for a program office. The ITDC, in conjunction with the Deployable Joint Command and Control (DJC2) program office, supports the fielding of prototype capabilities, in support of Standing Joint Force Headquarters (SJFHQ) standup. In later years, it will provide interoperability demonstrations venues for all systems or programs in a common Joint Command & Control environment.
- The successful fielding of interoperable Joint Command & Control is equally dependent on the ITDC as well as the successful completion of the traditional operational assessment process. Both processes support the acquisition process, as it needs to be implemented in support of SJFHQ standup and other DOD transformation programs. The traditional operational assessment process supports the assessment of (rapid) operational prototypes in operational prototype experiments. These operational prototypes are developed as enablers to approved concepts created out of concept experiments and lead to identification of interim capabilities and requirements for fielding. The ITDC provides interoperability demonstrations of (controlled) pilot capability implementations in coordination with and under consideration for fielding by a joint program office, such as DJC2. Successful assessment of a candidate capability to be fielded in an interoperability demonstration will ensure the capability is "born joint", and support a fully interoperable JC2E on the battlefield.

FY 2005 PLANS:

- Continue refining the prototypes as enablers to approved concepts created out of concept experiments and lead to identification of interim capabilities and requirements for fielding. The ITDC provides interoperability demonstrations of (controlled) pilot capability implementations in coordination with and under consideration for fielding by a joint program office, such as DJC2. Discover new capabilities and systems of

systems modifications to provide innovation and planning for future enhancements by using emerging technologies to improve the integration and interoperability of warfighting command and control and information superiority.

	FY02	FY03	FY04	FY05
Limited Objective Experiments (LOE)	4,885	10,800	11,950	11,000

FY 2002 ACCOMPLISHMENTS:

- Peer-to-Peer LOE explored the contributions of peer-to-peer collaboration in support of Rapid Decisive Operations by examining the ease of setup, mobility, redundancy/survivability, functionality, and security of peer-to peer collaboration systems.
- Operational Net Assessment (ONA) LOE, Phase I, focused on the Operational Net Assessment product and process, but included an assessment of the Contingency Operations (CONOPS) for Information Operations, Inter-agency Community, and Effects Based Planning.
- Focused Logistics (FL) LOE explored the integration of advanced technologies with logistics management to effectively support early force deployment, continued force employment and improve strategic deployment of forces capable of projecting joint forces by sea, land and air. The LOE concentrated on specific aspects relating to force deployment refining the logistics organization, functional relationships, planning, coordinating and executing distributed missions between the Combatant Commander's Joint Theater Logistics Management Center (JTLMC), and the Joint Task Force (JTF).
- Multi-National (MN) LOE focused on collaborative planning with multi-national partners who are executing Rapid Decisive Operations when the period is short. It compared the plan developed using a more traditional process with a plan using an integrated planning process.
- Effects Tasking Order (ETO)-to-Action LOE focused on effects based planning, execution and assessment, but also included a review of the Standing Joint Command and Control Element (SJC2E) Contingency Operations (CONOPS) as it relates to collaboration with functional components.

FY 2003 PLANS:

- Focused Logistics (FL). There is an integration of advanced technologies with logistics management supporting early force deployment and continued force employment through a series of Focused Logistics Limited Objective Experiments. Emphasis this year is on developing Sea-based logistics sustainment and a web-based logistics process and system to support Joint Operational Warfighting using strategic in-theater systems as an essential element of Joint Deployment.
- Assured Access. Refinement of the Assured Access Concept happens through the execution of Limited Objective Experiments and the preliminary planning and coordination for the Impact/Vision experiments. The concept explores how a Joint Force Commander gains the requisite level of physical, spectral and cyber access to an adversary's domain.

- Interagency (IA)LOE. Develop the ability to apply all National Agency assets (e.g. Department of State, Federal Emergency Management Agency (FEMA), National Security Agency (NSA), and others) to any asymmetrical threat in order to break the will of the adversary. Limited Objective Experiments concentrate on establishing necessary links, protocols and procedures for interagency Common Relevant Operational Picture (CROP) and participation.
- Multi-National(MN)Information Sharing LOE. Continue the series of experiments with multi-national partners to define and refine coalition participation in the Impact 2003 and Vision 2004 experiments. The LOE will explore information sharing, Coalition Common Relevant Operational Picture (CCROP) and collaboration during Rapid Decisive Operations—Next Decade with coalition partners.
- Standing Joint Force Headquarters (SJFHQ) Prototype LOE. Tasking initiated by the Secretary of Defense to further develop the organization and doctrine for a joint command and control aspect for a rapid decisive operation. When fully operational, this emerging command and control structure will transform the preemptive and follow-on options for a unified Combatant Commander's (C/C). This will provide the Combatant Commander with an increased range of options for crisis response within his area of responsibility.

FY 2004 PLANS:

- Low Collateral Damage Weapons (LCDW). These are weapons systems used at the operational level to minimize civilian lives lost, infrastructure damage to the area around the target, and damage to the structure of the target itself in many cases. (Low Collateral Damage Weapons are not to be confused with non-lethal weapons, although they share some technologies and applications.) These weapons can enable the joint force commander to engage critical targets within the constraints of restrictive rules of engagement.
- Effects-Based Operations (EBO). A process for obtaining a desired strategic outcome or "Effect" on the enemy through synergistic and cumulative application of the full range of military/non-military capabilities at all levels of conflict.
- Joint Intelligence, Surveillance and Reconnaissance (JISR). A network-centric approach to the management of Intelligence Surveillance Reconnaissance platforms and sensors to better support the quick paced demands of Effects Based Operations.
- Focused Logistics (FL). Focused Logistics is the fusion of logistics information and transportation technologies for rapid response, deployment and sustainment; the ability to track and shift units, equipment, and supplies even while enroute, and delivery of tailored logistics packages. It also calls on the need to accelerate the deployment process by compressing the time required for Reception, Staging, Onward-movement, and Integration (RSO&I). This concept advocates the exploration of new, emerging, and notional lift platforms and technologies such as High Speed Sealift (HSS) and Theater Support Vessels (TSVs). Joint Forces Command will examine the utility of establishing a Joint Logistics Command concept.
- Time Sensitive Targeting (TST). Time Sensitive Targeting is a requirement to find and destroy mobile theater missile infrastructure nodes and some selected asymmetrical threats. This became Joint Theater Air and Missile Defense Attack Operations. Low collateral damage weapons and "other methods" incorporate into the concept.

Execution of Time Sensitive Targeting remains at the functional component level (and lower) for the near future. The purpose is to: shorten engagement timelines for high priority emerging targets; to exploit and harmonize ongoing service efforts into a joint concept of operations; to fully support the precision engagement vision in Joint Vision 2020; to support service experimentation efforts; and to realize near-/mid-term doctrine payoffs.

- Information Operations (IO). Information Operations use the information medium to apply various capabilities to produce or create effects that influence decision-making, behavior, and will. The ultimate targets of information operations are adversary decision makers, their decision-making processes, and their decision support systems. Operations that are effects-based set the conditions for the enemy to fail. Information Operations are critical to Effects-Based Operations because they create anticipation/belief by the enemy of their impending failure.
- Assured Access. One of the key enablers of the Rapid Decisive Operations concept is joint operations that assure friendly force access to the battle space. Assured access enables the joint force command to set and sustain the battle space conditions necessary to allow the joint force to reach the adversary's center of gravity. It is a critical pre-condition to achieving the effects prescribed by the joint force commander is part of every Combatant Commander's (C/C) Theater Engagement Plan.

FY 2005 PLANS:

- Low Collateral Damage Weapons (LCDW). Continue working on weapons systems used at the operational level to minimize civilian lives lost, infrastructure damage to the area around the target, and damage to the structure of the target itself in many cases.
- Effects Based Operations (EBO). Continue discovery, expansion and refinement of the process for obtaining a desired strategic outcome or "Effect" on the enemy through synergistic and cumulative application of the full range of military/non-military capabilities at all levels of conflict.
- Joint Intelligence, Surveillance and Reconnaissance (JISR). A network-centric approach to the management of Intelligence Surveillance Reconnaissance platforms and sensors to better support Effects Based Operations.
- Focused Logistics (FL). Continue to accelerate the deployment process by compressing the time required for Reception, Staging, Onward-movement, and Integration (RSO&I). Continue exploration of new, emerging, and notional lift platforms and technologies such as High Speed Sealift (HSS) and Theater Support Vessels (TSVs). Continue examining the establishment of a Joint Logistics Command concept.
- Joint Urban Operations (JUO). USJFCOM is the executive agent for the coordination of the overarching joint concept development and experimentation and requirements generation studies for joint urban operations, while integrating Service and U.S. Special Operations Command Title X. JFCOM provides support to Joint Warfighting Science and Technology planning and recommending sponsors for joint urban operations-related Advanced Concepts Technology Demonstrations to the Secretary of Defense via CJCS. As required, Joint Experimentation will review requirement documents for joint urban operations mission needs.

- Time Sensitive Targeting (TST). Continuing requirement to find and destroy mobile theater missile infrastructure nodes and some selected asymmetrical threats. This became Joint Theater Air and Missile Defense Attack Operations. Low collateral damage weapons and "other methods" incorporate into the concept. Execution of Time Sensitive Targeting remains at the functional component level (and lower) for the near future. The purpose is to continue efforts on: shortening engagement timelines for high priority emerging targets; exploiting and harmonizing ongoing service efforts into a joint concept of operations; to fully support the precision engagement vision in Joint Vision 2020; to support service experimentation efforts; and to realize near-/mid-term doctrine payoffs.
- Information Operations (IO). Information Operations use the information medium to apply various capabilities to produce or create effects that influence decision-making, behavior, and will. The ultimate targets of information operations are adversary decision makers, their decision-making processes, and their decision support systems. Operations that are effects-based set the conditions for the enemy to fail. Information Operations are critical to Effects-Based Operations because they create anticipation/belief by the enemy of their impending failure.

	FY02	FY03	FY04	FY05
Concept Development	10,383	15,210	21,132	20,000

FY 2002 ACCOMPLISHMENTS:

- Future experimentation efforts continued to be dependent on an aggressive, continuous effort to develop concepts relating to transformation. A robust and aggressive concept development program that aligned with the Joint Experimentation Campaign Plan and focused on high priority tasks required concept development workshops and seminars, analytical wargames, and limited objective experiments supported by virtual and constructive simulation. Joint Experimentation was focused nearly exclusively on the Rapid Decisive Operations concept, and only five of its supporting concepts. Joint Experimentation targeted additional work on at least 24 emerging concepts including the next integrating concept after Rapid Decisive Operations over the 2003-2007 timeframe, and critical concepts such as: Assured Access, Multi-national operations, interagency operations, focused logistics, Joint Intelligence, Surveillance and Reconnaissance (JISR), and Joint Operational Warfighting (JOW).

FY 2003 PLANS:

- Experimentation efforts after the conclusion of Millennium Challenge 2002 experiment will continue to be dependent upon an aggressive, continuous effort to develop concepts relating to transformation. The Rapid Decisive Operations (RDO)—Next Decade concept will integrate Knowledge/Command and Control (K/C2), and Effects-Based Operations to achieve the desired political/military effort. This will continue to require a robust and aggressive level of effort of concept development that aligns with the Joint Experimentation Campaign Plan and focuses on high priority tasks assigned. Activities continue looking at emerging technologies in the 2020-2030 timeframe that may lead to far-term changes in the joint force.

- Begin development of the next integrating concepts, Joint Capstone Concept (JCC), that evaluates "how" to fight and overcome the will of the adversary.

FY 2004 PLANS:

- Experimentation efforts continue to be dependent upon an aggressive, continuous effort to develop concepts relating to transformation. The integrating concepts of Rapid Decisive Operations (RDO) –Next Decade and Joint Capstone Concepts (JCC) integrate Knowledge/Command and Control (K/C2), Operational Net Assessment (ONA) and Effects-Based Operations to achieve the desired political/military effort. Activities continue looking at emerging technologies in the 2020-2030 timeframe that may lead to far-term changes in the joint force. The concept development operations plan will support development of recommendations for the FY05 Quadrennial Defense Review and JFCOM's primary transformation mission.

FY 2005 PLANS:

- Experimentation efforts depend upon an aggressive, continuous effort to develop concepts relating to transformation, requiring a robust and aggressive level of effort of concept development that aligns with the Joint Experimentation Campaign Plan, the FY05 Quadrennial Defense Review, and high priority tasks assigned. Concept development will include: Projecting the force; Protecting the joint force; Supporting the Joint Force; non-contiguous Joint Suppression of Enemy Air Defense (JSEAD), and more concepts currently under-worked or not worked. Additionally, the Defense Planning Guidance notes more capabilities need developing: Stealth vs. non-stealth, Manned vs. unmanned, new competitive opportunities in sensors, and Intelligence Surveillance Reconnaissance, and Strategic Lift.

	FY02	FY03	FY04	FY05
Innovation and Exploration Futures Alliance/Project Alpha	2,735	4,030	5,470	5,560

FY 2002 ACCOMPLISHMENTS:

- Activities continued to look at emerging technologies that could lead to near-/mid-/far-term changes in the joint force. This was done through a series of seminars, workshops, and the leveraging of the Service wargames. Project Alpha Team formed a partnership with the Science Engineering Research Affiliate (SERA) in an effort to extend the reach of JFCOM through collaborative relationships with Service, Defense Advanced Research Project Agency (DARPA), University Affiliated Research Centers, and Department of Energy Labs. The objective was to include representatives of these organizations as partners in transformation.

FY 2003 PLANS:

- USJFCOM is initiating a quick turn around analytical modeling capability to rapidly assess new ideas and their feasibility for full concept development and experimentation. Analytical modeling allows us to assess

the "pay back" potential on ideas without investing large amounts of resources until viability is proven. Project Alpha initiatives include Swarming Unmanned Aerial Vehicles (UAVs). Swarming Unmanned Aerial Vehicles concept uses 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 refining the analytical model to rapidly assess new ideas and their feasibility for full concept development and experimentation. With the assistance of Defense Advanced Research Project Agency (DARPA), other Department of Defense agencies, Multi-National, and Inter-Agency collaboration, experiments are continuously on going and partnered or leveraged to examine emerging technologies. Innovation and exploration efforts continue for impacting 2025-2040 timeframe. Investigation continues in areas of Hard-to-Get Signals, sensor development, Low Collateral Damage Weapons (LCDW) and Non-Lethal Weapons among others.

FY 2005 PLANS:

- As in 2004, USJFCOM continues refining the analytical model to rapidly assess new ideas and their feasibility for full concept development and experimentation. With the assistance of Defense Advanced Research Project Agency (DARPA), other Department of Defense agencies, Multi-National, and Inter-Agency collaboration, experiments are continuously on going and partnered or leveraged to examine emerging technologies. Innovation and exploration efforts continue for impacting 2025-2040 timeframe. Investigation continues in areas of Hard-to-Get Signals, sensor development, Low Collateral Damage Weapons (LCDW) and Non-Lethal Weapons among others.

	FY02	FY03	FY04	FY05
Integration with other regional Combatant Commanders, Military Services and Agencies.	2,149	4,570	5,663	6,040

FY 2002 ACCOMPLISHMENTS:

- Continued communication efforts coordinating concept development and experimentation through a series of meetings, workshops and seminars were critical to thorough planning of Millennium Challenge experiment. These workshops were designed to adequately capture and assess Combatant Commander's (C/C) current joint warfighting needs and directions for experimentation. The key activities (workshops) were as follows:
  - Army Transformation Wargame
  - Air Force Futures

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Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603727N Project Number: R2497
PROGRAM ELEMENT TITLE: Joint Experimentation Project Title: Joint Experimentation

FY 2003 PLANS:

- Continued communication efforts to fully coordinate planned concept development and experimentation through a series of meetings, workshops and seminars. Adequately capture and assess current joint warfighting needs and directions for experimentation. This is done through a continued series of seminars and workshops, and the leveraging of the Service and Title X wargames. The key activities (workshops and seminars) are as follows:
  - JFCOM's Pinnacle Impact 2003
  - Navy Wargame Series (Four) – Sea Basing, Sea Strike, Force Net & Sea Shield
  - Air Force Global Engagement VI
  - Army Transformation Wargame
  - OSD Transformation Wargame Series
  - SPACECOM Schriever
  - SOCOM Vision Series (Three)
  - USMC Expeditionary Warrior

FY 2004 PLANS:

- Continued communication efforts to fully coordinate planned concept development and experimentation through a series of meetings, workshops and seminars. Adequately capture and assess current joint warfighting needs and directions for experimentation. This is done through a continued series of seminars and workshops, and the leveraging of the Service and Title X wargames. The key activities (workshops and seminars) are as follows:
  - JFCOM's 2004 Joint Global Wargame
  - Terminal Fury (PACOM SJFHQ Refinement)
  - Air Force Futures
  - Army Transformation Wargame
  - SOCOM Vision Series (One)
  - OSD Transformation Wargame Series
  - USMC Expeditionary Warrior
  - Other Wargames To Be Determined

FY 2005 PLANS:

- Continued communication efforts to fully coordinate planned concept development and experimentation through a series of meetings, workshops and seminars. Adequately capture and assess current joint warfighting needs and directions for experimentation. This is done through a continued series of seminars and workshops, and the leveraging of the Service and Title X wargames. The key activities (workshops and seminars) are as follows:
  - JFCOM executing Impact (2005) and planning Vision (2006) Experiments
  - Internal Look (CENTCOM SJFHQ Refinement)

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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603727N Project Number: R2497
PROGRAM ELEMENT TITLE: Joint Experimentation Project Title: Joint Experimentation

- Navy Global Wargame
- OSD Transformation Wargame Series
- USMC Expeditionary Warrior
- SPACECOM Schriever
- Army Transformation Wargame
- SOCOM Vision Series (Two)
- Air Force Global Engagement VII
- DARPA Technology Wargames
- Other Wargames To Be Determined

	FY02	FY03	FY04	FY05
Multi-national and Coalition Concept Development	1,954	3,500	4,650	4,750

FY 2002 ACCOMPLISHMENTS:

- USJFCOM continued the exploration of the multi-national concept of operations, engagement, education and collaboration with our multi-national partners through a series of Limited Objective Experiments that explored information sharing and collaboration during Rapid Decisive Operations. The multi-national experimentation efforts were embedded in our experimentation efforts.

FY 2003 PLANS:

- Continued exploration of the Multi-National (MN) collaboration, multi-level security and knowledge building issues – all J9 concept issues. JFCOM will address the Chairman Joint Chief of Staff's task to explore Coalition Information Sharing. Major emphasis will be on Operational Net Assessment (ONA) collaboration, dynamic updating and how other nation's Joint Force Headquarters integrate with ours requiring a new ONA scenario free of political and security sensitivities. We are building the ONA "backbone" to support Multi-National products from our coalition partners.

FY 2004 PLANS:

- JFCOM will continue exploring the Multi-National (MN) concept of operations, engagement, education and collaboration with our MN partners. This is through a series of Limited Objective Experiments that explores information sharing, Multi-Level Security (MLS), and Coalition Common Relevant Operating Picture (CCROP) during Rapid Decisive Operations (RDO)-Next Decade and Joint Warfighting Concept (JWC). The multi-national experimentation efforts continue to be embedded in all our other experimentation efforts.

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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603727N Project Number: R2497
PROGRAM ELEMENT TITLE: Joint Experimentation Project Title: Joint Experimentation

FY 2005 PLANS:

- JFCOM will continue exploring the Multi-National (MN) concept of operations, engagement, education and collaboration with our MN partners. JFCOM continues to increase the visibility of our MN partners needing access to vital information and emphasizing system technology improvements in Multi-Level Security (MLS).

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:

- 0601152N In-house Lab Independent Research
- 0601153N Defense Research Sciences
- 0602114N Power Projection Applied Research
- 0602123N Force Protection Applied Research
- 0602131M MC Landing Forces Tech
- 0602235N Common Picture Applied Research
- 0602236N Warfighter Sustainment Applied Research
- 0602271N RF Systems Applied Research
- 0602435N Ocean Warfighting Environment Applied Research
- 0602747N Undersea Warfare Applied Research
- 0602782N Mine & Expeditionary Warfare Applied Research
- 0603114N Power Projection Advanced Technology
- 0603123N Force Protection Advanced Technology
- 0603235N Common Picture Advanced Technology
- 0603236N Warfighter Sustainment Advanced Technology
- 0603271N RF Systems Advanced Technology
- 0603640M Marine Corps Advanced Technology
- 0603729N Warfighter Protection Advanced Technology
- 0603747N Undersea Warfare Advanced Technology
- 0603757N Joint Warfare Experiments
- 0603758N Naval Warfighting Experiments and Demo
- 0603782N Mine & Expeditionary Warfare Advanced Technology
- 0603750D Advanced Concept Technology Demonstration
- 0603727D Joint Warfighting Program

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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603727N Project Number: R2497
PROGRAM ELEMENT TITLE: Joint Experimentation Project Title: Joint Experimentation

D. ACQUISITION STRATEGY: Not Applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603729N
PROGRAM ELEMENT TITLE: Warfighter Protection Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2494 Center For Disaster Management	2,113							
R2715 Distributed Simulation Warfighting Concepts	4,951	3,325						
R2914 Warfighter Protection Advanced Technology	13,204	18,620	11,435	12,362	18,688	19,855	20,258	20,661
R9030 Organ Transfer Technology	1,921	2,933						
R9031 Damage Control Operational Concepts	1,633							
R9161 Medical Data Mining Tool	0	5,281						
R9162 Navy Medical System Configuration and Testbed	0	7,922						
R9163 Portable Sterile Water Production Device	0	977						
TOTAL	23,822	39,058	11,435	12,362	18,688	19,855	20,258	20,661

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program supports the development and demonstration of advanced technologies within the Warfighter Protection Future Naval Capability. Program goals include improved warfighter protection medical equipment, techniques 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. 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. Casualty Prevention includes enhancing warfighter situational awareness and countering threats from disease, battle and non-battle injuries. 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. Within the Naval Transformational 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".

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

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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603729N
PROGRAM ELEMENT TITLE: Warfighter Protection Advanced Technology

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	28,425	19,040	20,238	18,954
Adjustments from FY 2003 President's Budget:				
Congressional Plus-Ups		20,900		
Cong. Rescissions/Adjustments/Undist. Reductions	-136	-458		
Execution Adjustments	-3,040		-541	
NWCF Rate Adjustments			-37	-15
Efficiencies at NWCF Activities			-14	-16
S&T Program Adjustments			-7,947	-6,295
Pay Raise/Inflation Adjustments		-424	-264	-266
SBIR Reduction	-1427			
FY 2004/2005 President's Budget Submission	23,822	39,058	11,435	12,362

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

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603729N PROJECT NUMBER: R2914
PROGRAM ELEMENT TITLE: Warfighter Protection Advanced Technology PROJECT TITLE: Warfighter Protection Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2914 Warfighter Protection Advanced Technology	13,204	18,620	11,435	12,362	18,688	19,855	20,258	20,661

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFCATION: 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. 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. Casualty Prevention includes enhancing warfighter situational awareness and countering threats from disease, battle and non-battle injuries. 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. 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/PLANED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Casualty Care and Management	6,359	7,273	5,011	5,230

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 2002 ACCOMPLISHMENTS

Initiated:

- Initiated development of a device utilizing high intensity focused ultrasound (HIFU) technology for hemostasis (cauterization of the damaged vessel resulting in the cessation of hemorrhage). The technology included Doppler ultrasound technology for locating and imaging the site of arterial hemorrhage.
- Initiated development of a portable hand-held ultrasound device to be used in far forward situations for diagnostic application by the corpsman in the field. The effort defined system requirements for the use of portable ultrasound, and other medical devices, and supported information technology tools in combat casualty care

both ashore and afloat.

Continued:

- Continued development of a dressing that controls bleeding (hemostasis) and also incorporates an antimicrobial agent. The use of such a bandage would help lessen the risk of infection.
- Continued evaluation of all Food and Drug Administration (FDA) approved hypertonic crystalloids used in the treatment of hemorrhagic shock. This information will be used in the decision making process to select the most effective fluid manifesting the least adverse profile.
- Continued evaluation of a low volume colloid fluid that has recently gained FDA approval. This fluid will be compared and contrasted to low volume crystalloid resuscitation fluids for efficacy in the treatment of hemorrhage.
- Continued development of novel resuscitation fluids utilizing ketones, rather than lactate, as an energy source. The use of ketones avoids the problem of further elevating lactate levels when lactic acid levels are already excessive as in hemorrhagic shock.
- Continued development of resuscitation fluids containing a novel chemical that promotes oxygen distribution to tissues, thus preventing hypoxic injury to tissues due to hypoperfusion as a result of hemorrhage.
- Continued development of life sustaining drugs that maintain blood flow to vital organs. These drugs, if proven will improve morbidity and decrease mortality in the wounded.
- Continued development of novel oxygen carrying blood substitutes (heme containing peptides, pegylated liposome-encapsulated synthetic hemoglobin, freeze-dried red blood cells) and determine their oxygen carrying capabilities and immunogenic profile. Development of such agents would improve the logistical situation as compared with frozen red blood cells since they could be stored at higher temperatures (e.g., room temperature) and have a longer shelf life.
- Continued testing and evaluation of the shipboard medical grade water system under field conditions. This technology will provide continuous quantities of sterile USP grade water for medical use (e.g., reconstitution of lyophilized drugs and blood products) in a forward area.
- Continued development of the casualty management coordination system that would be integrated with existing forecasting programs that project casualty rates. The new programs will lead to a refinement in estimates and therefore enhance this capability, especially in Operations Other Than War (OOTW) and Operational Maneuvers From the Sea (OMFTS).

Completed:

- Completed development of hollow-fiber frozen red cell glycerolization/deglycerolization system. This system optimized the protocol of this process.
- Completed the investigation of the efficacy and safety of circumferential compression for the emergent management of pelvic ring disruptions by means of a non-invasive pelvic sling. Development of such a device will both stabilize the fracture and limit the extent of hemorrhage resulting from this type of injury.

FY 2003 PLANS

Initiate

- Initiate a study on the far forward treatment of hemorrhagic shock which will determine the most effective hemostatic agents for the control of life threatening bleeding, determine the optimal method of resuscitation following hemorrhage, and develop equipment and surgical techniques to improve the care of battlefield casualties.

Continue:

- Continue development of a portable hand-held ultrasound device to be used in far forward situations for diagnostic application by the corpsman in the field.
- Continue evaluation of all Food and Drug Administration (FDA) approved hypertonic crystalloids used in the treatment of hemorrhagic shock.
- Continue evaluation of a low volume colloid fluid that has recently gained FDA approval
- Continue development of novel resuscitation fluids utilizing ketones.
- Continue development of resuscitation fluids containing a novel chemical that promotes oxygen distribution to tissues.
- Continue development of a portable hand-held ultrasound device to be used in far forward situations for diagnostic application by the corpsman in the field.
- Continue development of life sustaining drugs that maintain blood flow to vital organs.
- Continue development of novel oxygen carrying blood substitutes.
- Continue development of the casualty management coordination system.

Complete:

- Complete development of a device utilizing high intensity focused ultrasound (HIFU) technology for hemostasis.
- Complete development of a dressing that controls bleeding (hemostasis) and also incorporates an antimicrobial agent.
- Complete testing and evaluation of the shipboard medical grade water system under field conditions.

FY 2004 PLANS

Initiate:

- Initiate clinical trials (Phase I) with trans-sodium crocetinate (TSC) in collaboration with Diffusion Pharmaceuticals; this is a joint effort with Army and DARPA.
- Initiate development of casualty management planning tools (software) that will be integrated with existing forecasting programs that project casualty rates & logistical requirements. These programs will enhance/upgrade

existing programs for Operational Maneuvers from the Sea (OMFTS), Operations Other Than War (OOTW), and Military Operations on Urbanized Terrain (MOUT) scenarios.

Continue:

- Continue a study on the far forward treatment of hemorrhagic shock.
- Continue development of a portable hand-held ultrasound device to be used in far forward situations for diagnostic application by the corpsman in the field.
- Continue evaluation of all Food and Drug Administration (FDA) approved hypertonic crystalloids used in the treatment of hemorrhagic shock.
- Continue evaluation of a low volume colloid fluid that has recently gained FDA approval
- Continue development of novel resuscitation fluids utilizing ketones.
- Continue development of resuscitation fluids containing a novel chemical that promotes oxygen distribution to tissues.
- Continue development of a portable hand-held ultrasound device to be used in far forward situations for diagnostic application by the corpsman in the field.
- Continue development of life sustaining drugs that maintain blood flow to vital organs.
- Continue development of novel oxygen carrying blood substitutes.
- Continue development of the casualty management coordination system.

FY 2005 PLANS

Initiate:

- Initiate development of a new resuscitation fluid for the treatment of hemorrhagic shock based upon studies previously conducted incorporating the most appropriate energy substrate and cytoprotective agents. To be developed jointly with Army and DARPA.

Continue:

- Continue clinical trials (Phase I) with trans-sodium crocetinate (TSC) in collaboration with Diffusion Pharmaceuticals LLC; this is a joint effort with Army and DARPA.
- Continue a study on the far forward treatment of hemorrhagic shock.
- Continue development of casualty management planning tools (software) that will be integrated with existing forecasting programs that project casualty rates & logistical requirements. Continue an ACTD with Army on the efficacy of nasal ketamine as an analgesic substitute for morphine.
- Continue development of a portable hand-held ultrasound device to be used in far forward situations for diagnostic application by the corpsman in the field.
- Continue development of life sustaining drugs that maintain blood flow to vital organs.

- Continue development of novel oxygen carrying blood substitutes.
- Continue development of the casualty management coordination system.

Complete:

- Complete evaluation of all Food and Drug Administration (FDA) approved hypertonic crystalloids used in the treatment of hemorrhagic shock.
- Complete evaluation of a low volume colloid fluid that has recently gained FDA approval.
- Complete development of novel resuscitation fluids utilizing ketones.
- Complete development of resuscitation fluids containing a novel chemical that promotes oxygen distribution to tissues.

	FY 02	FY 03	FY 04	FY 05
Casualty Prevention	5,930	10,078	5,600	6,350

Casualty Prevention includes enhancing warfighter situation awareness and countering threats from disease, battle and non-battle injuries.

FY 2002 Accomplishments

Initiated:

- Initiated development of agile laser eye protection. Advances in laser weapons and systems make development of agile protective systems critical for operations in the new battlespace. To effectively counter the agile laser threat, the device must be capable of responding throughout the visible spectrum to exposures ranging from sub nanosecond pulse to continuous wave. The device must be compatible with life support system, cockpit displays, phosphors and lighting, Night Vision Devices, and chemical biological (CB) protection systems.
- Initiated development of an airborne laser event recorder to operate independently in the cockpit for up to 6 hours and record up to 60 laser exposure events.
- Initiated development of Helicopter Aircrew Integrated Life Support Systems (HAILSS) to improve cooling capability while maintaining optimal CB protection for aircrew. HAILSS will: 1) increase aircrew performance by providing aircraft independent, body-mounted, conditioned air (microclimatic cooling and warmth), 2) provide CB protection, and 3) reduce the number of single components, overall weight and mass of current USN/USMC aircrew ensemble configurations for rotary wing missions. HAILSS technology will be integrated into Tactical Aircrew Integrated Life Support (TAILSS) and to eventual Smart Aircrew Integrated Life Support System (SAILSS) which will incorporate physiologic monitoring.
- Initiated studies for development of an advanced multi-purpose diving system to provide expansion of current diver mission profile in warm and cold water operational environments.

- Initiated development of a body armor system to protect the terrestrial warrior against conventional and emerging ballistic and thermobaric weapons. Identified unique injury mechanisms from thermobaric weapons (TBW) to assist development of protective strategies against TBW.
- Initiated development of revised standard to reduce behind armor blunt trauma (BABT) in the terrestrial warfighter. Developed instrumentation and modeling of human torso response for non-penetrating ballistic impact from small arms fire and incorporate into thoracic models to: 1) simulate BABT, 2) model dynamic tissue deformation and 3) develop thoracic accelerometry (rib), intrathoracic pressure, intracranial (subarachnoid) pressure and validate simulated model. Developed revised standard to improve individual soldier protection gear to improve protection against conventional and emerging ballistic threats.
- Initiated development of Advanced Personal Environmental Control System to permit the warfighter extended operational time in hot climates using micro-cooling technology.
- Initiated development of a smart firefighter ensemble with embedded physiological sensors, individual computer, data capture, storage, interpretation, and telemetry, for both shipboard and terrestrial operations.
- Initiated development of rapid, noninvasive diagnostic for anthrax immunization and tuberculosis (TB) from saliva to permit rapid assessment of anthrax immune status and resistance to TB prior to deployment. Developed hand held rapid fluorescence polarization assay and device for rapid assessment in the field.

Completed:

- Completed efforts to enhance maintenance of spatial orientation to provide an integrated visually powerful cockpit/Helmet-Mounted Display (HMD) environment that can reduce or eliminate loss of Situational Awareness, overcome Spatial Disorientation, and allow the aviator to process information more rapidly.

FY 2003 PLANS

Continue:

- Continue development of agile laser eye protection.
- Continue development of airborne laser event recorder to operate independently in the cockpit for up to 6 hours and record up to 60 laser exposure events.
- Continue development of Helicopter Aircrew Integrated Life Support Systems (HAILSS) to improve cooling capability while maintaining optimal CB protection for aircrew.
- Continue studies for development of an advanced multi-purpose diving system to provide expansion of current diver mission profile in warm and cold water operational environments.
- Continue development of a body armor system to protect the terrestrial warrior against conventional and emerging ballistic and thermobaric weapons.
- Continue development of Advanced Personal Environmental Control System to permit the warfighter extended

operational time in hot climates using micro-cooling technology.
- Continue development of a smart firefighter ensemble with embedded physiological sensors, individual computer, data capture, storage, interpretation, and telemetry, for both shipboard and terrestrial operations.
- Continue development of rapid, noninvasive diagnostic for anthrax immunization and tuberculosis (TB) from saliva to permit rapid assessment of anthrax immune status and resistance to TB prior to deployment.

Complete:
- Complete development of revised standard to reduce behind armor blunt trauma (BABT) in the terrestrial warfighter.

FY 2004 PLANS

Continue:
- Continue development of agile laser eye protection.
- Continue development of airborne laser event recorder to operate independently in the cockpit for up to 6 hours and record up to 60 laser exposure events.
- Continue development of Helicopter Aircrew Integrated Life Support Systems (HAILSS) to improve cooling capability while maintaining optimal CB protection for aircrew.
- Continue studies for development of an advanced multi-purpose diving system to provide expansion of current diver mission profile in warm and cold water operational environments.
- Continue development of a body armor system to protect the terrestrial warrior against conventional and emerging ballistic and thermobaric weapons.
- Continue development of Advanced Personal Environmental Control System to permit the warfighter extended operational time in hot climates using micro-cooling technology.
- Continue development of a smart firefighter ensemble with embedded physiological sensors, individual computer, data capture, storage, interpretation, and telemetry, for both shipboard and terrestrial operations.
- Continue development of rapid, noninvasive diagnostic for anthrax immunization and tuberculosis (TB) from saliva to permit rapid assessment of anthrax immune status and resistance to TB prior to deployment.

Complete:
- Complete development of a body armor system to protect the terrestrial warrior against conventional and emerging ballistic and thermobaric weapons.

FY 2005 PLANS

Continue:
- Continue development of Helicopter Aircrew Integrated Life Support Systems (HAILSS) to improve cooling capability

while maintaining optimal CB protection for aircrew.

- Continue development of rapid, noninvasive diagnostic for anthrax immunization and tuberculosis (TB) from saliva to permit rapid assessment of anthrax immune status and resistance to TB prior to deployment.

Complete:

- Complete development of airborne laser event recorder to operate independently in the cockpit for up to 6 hours and record up to 60 laser exposure events. Transition to Naval Air Systems Command.
- Complete development of agile laser eye protection. Transition to Naval Air Systems Command.
- Complete studies for development of an advanced multi-purpose diving system to provide expansion of current diver mission profile in warm and cold water operational environments. Transition to NAVSEA 00C.
- Complete development of Advanced Personal Environmental Control System to permit the warfighter extended operational time in hot climates using micro-cooling technology.
- Complete development of a smart firefighter ensemble with embedded physiological sensors, individual computer, data capture, storage, interpretation, and telemetry, for both shipboard and terrestrial operations. Transition to NAVSEA, PEO SEA 05.

	FY 02	FY 03	FY 04	FY 05
Healthy and Fit Force	915	1,269	824	782

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 2002 ACCOMPLISHMENTS

Initiated:

- Initiated development of affordable, reliable, easy-to-use hearing protection that allows aviation personnel safe extended exposures of up to 150 dB.
- Initiated effort to determine the human/neck injury tolerance to aircraft maneuvering acceleration. This effort will enhance mission effectiveness by minimizing injury, reducing medical rehabilitation costs, and reducing a need for aircrew replacement training.
- Initiated effort to prevent injury to Special Operations personnel using fast boats by developing seat shock mitigation system for small Fast Boats.

Continued:

- Continued the treatment and prevention of noise-induced hearing loss using antioxidants. Utilized a multi-tiered approach to increase resistance to damage and enhance repair after injury. Utilized safe therapeutics already approved by FDA for protection and rescue and develop inner ear drug delivery system.

FY 2003 PLANS

Continue:

- Continue development of affordable, reliable, easy-to-use hearing protection that allows aviation personnel safe extended exposures of up to 150 dB.
- Continue effort to determine the human/neck injury tolerance to aircraft maneuvering acceleration.
- Continue effort to prevent injury to Special Operations personnel using fast boats by developing seat shock mitigation system for small Fast Boats.
- Continue the treatment and prevention of noise-induced hearing loss using antioxidants.

FY 2004 PLANS

Continue:

- Continue development of affordable, reliable, easy-to-use hearing protection that allows aviation personnel safe extended exposures of up to 150 dB.
- Continue effort to determine the human/neck injury tolerance to aircraft maneuvering acceleration.
- Continue effort to prevent injury to Special Operations personnel using fast boats by developing seat shock mitigation system for small Fast Boats.
- Continue the treatment and prevention of noise-induced hearing loss using antioxidants.

FY 2005 PLANS

Continue:

- Continue effort to determine the human/neck injury tolerance to aircraft maneuvering acceleration.
- Continue effort to prevent injury to Special Operations personnel using fast boats by developing seat shock mitigation system for small Fast Boats.
- Continue the treatment and prevention of noise-induced hearing loss using antioxidants.

Complete:

- Complete development of affordable, reliable, easy-to-use hearing protection that allows aviation personnel safe extended exposures of up to 150 dB.

C. OTHER PROGRAM FUNDING SUMMARY

RELATED 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:

R2494	FY 02	FY 03
Center For Disaster Management	2,113	0

Provided support to U.S. Southern Command (USSOUTHCOM) by researching issues related to natural and man-made disasters in the Latin American and Caribbean area of responsibility. Effort included the prevention or mitigation of causative or contributing factors, and the humanitarian response to those disasters.

R2715	FY 02	FY 03
Distributed Simulation Warfighting Concepts	4,951	3,325

Examines the warfighting and weapon system design concepts and their relationship to future aircraft carrier designs.

R9030	FY 02	FY 03
Organ Transfer Technology	1,921	2,933

Pre-clinical and clinical investigations directed at demonstrating the induction of tolerance to transplanted foreign tissues in the recipient through use of certain immunological reagents. This technology will allow treating a patient at the time of transplant with certain immune reagents that will cause the transplanted tissue/organ to be accepted as "self" by the host immune system. If the technology is effective, the 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 02	FY 03
Damage Control Operational Concepts-Distributed Damage	1,633	0

Supported Damage Control Operations through the development and demonstration of 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 provided visibility of real-time assessment of ship hull damage and compartment flooding which allowed for optimization and prioritization of flooding control and stability response strategies. The brassboard demonstration considered technologies demonstrated on the ex-USS Shadwell.

R9161	FY 02	FY 03
Medical Data Mining Tool	0	5,281

Initiate development of Medical Data Mining Tools designed to enhance the medical common operational picture. The Medical Data Mining Tool (MDMT) Project will advance Navy medical surveillance capability through the development of a

system that integrates the Medical Data Surveillance System (MDSS) with the DoD Health Care enterprise system, Theater Medical Information Project (TMIP).

R9162	FY 02	FY 03
Navy Medical System Configuration and Testbed	0	7,922

Initiate the Navy Medical System Configuration and Test Bed (N-MSCTB) project. This project establishes a capability for expediting the delivery of emerging technologies from Navy Medical R&D to DoD healthcare. The Naval Health Research Center has developed and identified several technology concepts to enhance force health protection. These concepts require further development and systems integration prior to actual field-testing

R9163	FY 02	FY 03
Portable Sterile Water Production Device	0	977

Advanced testing of a lightweight, man-portable, disposable device for producing water suitable for injection from potable water in the field.

R2333	FY 02	FY 03
Rural Health	*	0

This program supported remote medical education, training and telemedicine in rural America. (*Appropriated in FY02 in PE 0603706N, $6,532)

R2334	FY 02	FY 03
Bone Marrow Program	*	0

Supported the National Marrow Program/Registry, funding research associated with transplantation. (*Appropriated in FY02 in PE 0603706N, $27,825)

R2492	FY 02	FY 03
Medical Readiness Telemedicine Initiative Follow-On	*	0

Funds supported Navy Participation in the Joint Medical Operations (Telemedicine) Advanced Concepts Demonstration (ACTD). This ACTD is aimed at changing business practices in the delivery of medical services during warfare. (*Appropriated in FY02 in PE 0603706N, $7,397)

R2714	FY 02	FY 03
Teleradiology	*	0

A collaborative research effort between the Uniformed Services University of the Health Sciences, the National Naval Medical Center, and the University of South Florida in computer aided diagnostics and digital x-ray imaging to develop advanced applications in digital mammography and telemammography. (*Appropriated in FY02 in PE 0603706N, $961)

R2834	FY 02	FY 03
Robot Eyes	*	0

Integrated an existing optical sensing system with various devices, to include prosthetic devices, that have the capability to perform delicate tasks requiring precision manipulative skills. (*Appropriated in FY02 in PE 0603706N, $2,401)

R2836	FY 02	FY 03
Vector Vaccine	*	0

Funds addressed delivery methods for DNA vaccines, per vaccine program between industry and the Naval Medical Research Center. (*Appropriated in FY02 in PE 0603706N, $961)

R9000	FY 02	FY 03
Nursing Telehealth Applications	*	0

An international effort by a consortium of military medical technicians, educators, researchers, and domestic rural health care providers to design and deliver a nurse training curriculum to remote international locations with special emphasis on emergency medical training and humanitarian relief. (*Appropriated in FY02 in PE 0603706N, $2,501)

R9001	FY 02	FY 03
Mobile Integrated Diagnosis and Data Analysis System (MIDDAS)	*	0

Support for the Mobile Integrated Diagnosis and Data Analysis System was provided to complete the transition to a fully integrated and functional field demonstration unit. (*Appropriated in FY02 in PE 0603706N, $963)

R9002	FY 02	FY 03
Minimally Invasive Surgical Technology Institute	*	0

Support provided for the Minimally Invasive Surgical Technology Institute to develop various minimally and non-invasive monitoring and video-assisted medical techniques. (*Appropriated in FY02 in PE 0603706N, $961)

R9003	FY 02	FY 03
Biomedical Research Imaging Core – COH National Medical Center	*	0

Funds supported the Biomedical Research Imaging Core to advance the understanding of breast and prostate cancer and other diseases requiring the use of bone marrow transplantation. (*Appropriated in FY02 in PE 0603706N, $3,843)

R9004	FY 02	FY 03
Portable Production of Sterile Water for Intravenous	*	0

Funds provided for the improvement of an existing light-weight, man-portable, disposable device to produce suitable water for injection, while in the field, from potable field water. (*Appropriated in FY02 in PE 0603706N, $961)

R9005	FY 02	FY 03
Community Hospital Telehealth Consortium	*	0

Support for the Community Hospital Telehealth Consortium, a community-based healthcare service project organized around 6 not-for-profit community hospitals. (*Appropriated in FY02 in PE 0603706N, $1,442)

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603747N
PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2916 Undersea Warfare Advanced Technology	48,244	39,240	38,168	45,475	41,505	45,292	46,179	47,087
R2844 Magnetrestrictive Transduction	2,017							
R2846 Low Frequency Broadband Acoustic Airgun Source	1,256							
R9164 Motorized Airgun Program	0	978						
R9165 University Oceanographic Laboratory	0	3,423						
Total	51,517	43,641	38,168	45,475	41,505	45,292	46,179	47,087

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). Technologies being developed within this Program Element 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.

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

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603747N
PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	59,175	40,125	40,966	39,258
SBIR Adjustment	-341			
NWCF Rate Adjustment			-293	-217
Congressional Plus-Ups		+4,500		
Cong Rescissions/Adjustments/Undist Reductions	-289	-511		
Execution Adjustments	-7,028			
S&T Program Adjustments			-1,624	+7,414
Pay Raise/Inflation Adjustments		-473	-881	-980
FY 2004/2005 President's Budget Submission:	51,517	43,641	38,168	45,475

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable.
Technical: Not Applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603747N Project Number: R2916
PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology Project Title: Undersea Warfare Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2916/Undersea Warfare Advanced Technology	48,244	39,240	38,168	45,475	41,505	45,292	46,179	47,087

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:

	FY02	FY03	FY04	FY05
Wide Area Anti-Submarine Warfare (ASW) Surveillance	15,610	12,910	13,519	14,674

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 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, multi-static operation, supported by passive/active signal processing with the objective of increased detection capabilities. This activity includes support to Project Morgan; details are of a higher classification.

FY 2002 ACCOMPLISHMENTS:

- **Multistatic Anti-Submarine Warfare (ASW) (Component of Littoral Anti-Submarine Warfare (LASW) Future Naval Capability (FNC))**

  Initiated:
  - Development of automated multi-static sonar signal classification algorithms for coherent and incoherent sound sources to improve submarine detection performance in littoral waters.
  - Requirements and technology study for a small-size, lightweight, low frequency sound source for use in Navy multistatic sonar systems.
  - Development of a small size, lightweight, low frequency sound source for use in Navy multistatic sonar systems.

  Completed:
  - In-buoy signal processing software Build 1 laboratory test which demonstrated improved performance compared to existing systems.
  - Integration and testing of the long-life thermal source for a prototype long-endurance off-board source in Mk48 torpedo form factor.
  - Development of battery-powered prototype long-endurance off-board source in Mk48 torpedo form factor.
  - Transition of Deployable Multistatics technology into ASTO Submarine Combat Systems Improvements projects funded by PE 0603561N.

- **Deployable Autonomous Distributed System (DADS) (Component of LASW FNC)**

  Continued:
  - Development and testing of shallow water, deployable, uncabled, autonomous sensor system technologies in preparation for an FY05 barrier demonstration.
  - At-sea testing of a five-node design to verify sensor stability, array element localization capability, acoustic/non-acoustic track fusion and automatic feature extraction.
  - Algorithm development and validation.

- **Claymore Marine (This effort was previously reported under Battlegroup ASW Defense)**

  Continued:
  - Development and interim testing of an on-board, in-flight, real-time processor and associated detection algorithms. Additionally, continued assessment of a "strawman" Engineering Development Model (EDM).

  Completed:
  - Analysis of System Characterization Test data. The results were analyzed and incorporated into preparations for the Tactical Test involving a cooperative target; data were processed post-flight vice real-time.
  - FY02 Tactical Test.

FY 2003 PLANS:

- **Multistatic Anti-Submarine Warfare (ASW)**

  Initiate:
  - Laboratory testing and refinement of increasingly capable in-the-sonobuoy signal processing software builds.

- Development of a concept of operations and performance requirements for a new multistatic sonar system comprised of remotely operated sound sources and receivers.
- Development of an over-the-horizon data link for a new multistatic sonar system comprised of remotely operated sound sources and receivers.
- Transition of Compact Deployable Multistatic Receiver signal processing algorithms to the Naval Air Systems Command Improved Extended Echo Ranging Program in P.E. 0604261N.

Continue:
- Development of multistatic sonar signal classification algorithms for coherent and incoherent sound sources to improve submarine detection performance in littoral waters.
- Development of a small-size, lightweight, low frequency sound source for use in Navy multistatic sonar systems.

Complete:
- Requirements and technology study for a small-size, lightweight, low frequency sound source for use in Navy multistatic sonar systems.

- **Deployable Autonomous Distributed System (DADS).**

Continue:
- Algorithm development and validation.
- Development and testing of DADS technologies in preparation for FY05 barrier demonstration.
- At-sea testing of a five-node design to verify sensor stability, array element localization capability, acoustic/non-acoustic track fusion and automatic feature extraction.

- **Claymore Marine (This effort previously reported under Battlegroup ASW Defense)**

Continue:
- Assessment of the Engineering Development Model (EDM) and document results. Provide recommendation for a potential acquisition decision.

Complete:
- Development and interim testing of an on-board, in-flight, real-time processor and associated detection algorithms. Additionally, continued assessment of a "strawman" Engineering Development Model (EDM).
- Analysis of data from the FY02 Tactical Test and incorporate the results into planning for the Demonstration Test later in FY03.
- Development of the in-flight, real-time processor and advanced detection algorithms. Demonstrate processor technology during a Demonstration Test to include limited free-play against a non-cooperative target, with detections called in-flight.

FY 2004 PLANS:

- **Multistatic Anti-Submarine Warfare (ASW)**

Initiate:
- At-sea demonstrations of increasingly capable in-the-sonobuoy signal processing software builds.
- Construction of Advanced Development Model versions of compact deployable multistatic receivers (CDMR) and sources (CDMS) for use in at-sea demonstrations.

Continue:
- Development of multistatic sonar signal classification algorithms for coherent and incoherent sound sources to improve submarine detection performance in littoral waters.
- Laboratory testing and refinement of increasingly capable in-the-sonobuoy signal processing software builds.

Complete:
- Transition of Compact Deployable Multistatic Source waveform designs and performance to the Naval Air Systems Command Improved Extended Echo Ranging Program in P.E. 0604261N.
- Transition of Compact Deployable Multistatic Receiver signal processing algorithms to the Naval Air Systems Command Improved Extended Echo Ranging Program in P.E. 0604261N.
- Development of a small-size, lightweight, low frequency sound source for use in Navy multistatic sonar systems.
- Development of concept of operations and performance requirements for a new multistatic sonar system comprised of remotely operated sound sources and receivers.
- Development of an over-the-horizon radio data link for a new multistatic sonar system comprised of remotely operated sound sources and receivers.

- **Deployable Autonomous Distributed System (DADS) (Component of LASW FNC)**

Initiate:
- Test planning for FY05 barrier demonstration.

Continue:
- Development and testing of DADS technologies in preparation for FY05 barrier demonstration.

Complete:
- Validation of DADs baseline algorithm development.

- **Claymore Marine (Component of LASW FNC) (This effort was previously reported under Battlegroup ASW Defense)**

Complete:
- Assessment of the Engineering Development Model (EDM) and provide an acquisition recommendation. Transition technologies to Air ASW Systems.

FY 2005 PLANS:

- **Multistatic Anti-Submarine Warfare (ASW) (Component of LASW FNC)**

Continue:
- Laboratory testing and refinement of increasingly capable in-the-sonobuoy signal processing software builds.
- Development of multistatic sonar signal classification algorithms for coherent and incoherent sources to improve submarine detection performance in littoral waters.
- At-sea demonstrations of increasingly capable in-the-sonobuoy signal processing software builds.

Complete:
- Construction of Advanced Development Model versions of compact deployable multistatic receivers (CDMR) and sources (CDMS) for use in at-sea demonstrations.

- **Deployable Autonomous Distributed System (DADS) (Component of LASW FNC)**
  Initiate:
  - DADS system documentation.
  Complete:
  - Development and testing of DADS technologies in preparation for FY05 barrier demonstration.
  - DADS barrier demonstration.

	FY02	FY03	FY04	FY05
Battlegroup Anti-Submarine Warfare (ASW) Defense	15,520	10,009	10,251	15,017

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. Battgroup 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. This activity includes support to Project Morgan; details are of a higher classification.

FY 2002 ACCOMPLISHMENTS:

- **Sonar Automation (Component of Littoral Anti-Submarine Warfare (LASW) Future Naval Capability (FNC))**
  Initiated:
  - Sonar Automation Technology development plan to be used as a long-term master plan for the 6-year Sonar Automation Program.
  - Development, demonstration and transition of signal processing algorithms designed to detect and classify acoustic signatures of threat submarines.
  Completed:
  - Transition of Diesel Electric Submarine Speed-Related Tone feature detection for automatic detection and classification of threat diesel electric submarines to Naval Sea Systems Command under Program Element 0603561N (Advanced Submarine System Development), Project S0223 (Submarine Combat Systems Improvements).
  - Transition of auto-change detection and multi-sensor auto-classification processing features of IPAC to Naval Sea Systems Command under Program Element 0603561N (Advanced Submarine System Development), Project S0223 (Submarine Combat Systems Improvements).
  - Transition of striation auto detector signal processing algorithm to Naval Sea Systems Command under Program Element 0603561N (Advanced Submarine System Development), Project S0223 (Submarine Combat Systems Improvements).

- **High Frequency Broadband Transducer and Arrays for Submarines (Component of LASW FNC)**
  Initiated:
  - Development of HF candidate transducers and fabrication of partial arrays to demonstrate performance. Design types include triple resonant and ultra broadband transducers.
- **Limits of Passive Sonar (Component of LASW FNC)**
  Initiated:
  - Hardware component integration, testing and installation of an acoustic array testbed to support future passive sonar system designs.
  - Development of adaptive beamforming technology.
- **Lightweight Broadband Variable Depth Sonar (LBVDS) (Component of LASW FNC)**
  Completed:
  - Analysis and documentation of results from the FY 2001 LBVDS engineering shakedown and operational sea tests.
  - Development and demonstration of the LBVDS Demonstration System Model; transitioned acoustic source technologies and broadband signal processing to Program Element 0603513N (Shipboard System Component Development), Project 32468 (Undersea Warfare).
- **Environmentally Adaptive (EA) AN/SQQ-89 (Component of LASW FNC)**
  Continued:
  - Development of Environmentally Adaptive (EA) AN/SQS-53C (part of AN/SQQ-89) sonar signal processing and system control software.
  - Demonstrations of EA AN/SQS-53C sonar system technologies at sea using fleet test platforms.

FY 2003 PLANS:

- **Sonar Automation**
  Continue:
  - Development, demonstration and transition of signal processing algorithms designed to detect and classify acoustic signatures of threat submarines. Throughout the development process, algorithms will be transitioned to Naval Sea Systems Command under Program Element 0603561N (Advanced Submarine System Development), Project S0223 (Submarine Combat Systems Improvements).
  Complete:
  - Sonar Automation Technology development plan to be used as a long-term plan for the 6-year Sonar Automation Program.
- **High Frequency Broadband Transducer and Arrays for Submarines**
  Initiate:
  - Design and fabrication of prototype HF transducer array.
  Complete:

- Development of HF candidate transducers and fabrication of partial arrays to demonstrate performance. Design types include triple resonant types and ultra broadband.

- **Limits of Passive Sonar**
  Continue:
  - Hardware component integration, testing and installation of an acoustic array testbed to support future passive sonar system designs.
  - Development of adaptive beamforming technology.
- **Environmentally Adaptive SQQ-89 (Component of LASW FNC)**
  Complete:
  - Development of Environmentally Adaptive (EA) AN/SQS-53C (part of AN/SQQ-89) signal processing and system control software.
  - Multiple demonstrations of EA AN/SQS-53C sonar system technologies at-sea using fleet test platforms.
  - Development and Land-based Integration and Test System (LBITS) demonstration of EA AN/SQS-53C sonar system technologies. Transition technologies to P.E. 0205620N (Surface ASW Combat System Integration), (as an integral part of the Commercial Technology Transition Office-sponsored environmentally adaptive roll-on-roll-off adjunct to the AN/SQQ-89 and as upgrades to the AN/SQQ-89(V)15 and AN/SQQ-89A(V)15.

FY 2004 PLANS:

- **Sonar Automation (Component of LASW FNC)**
  Continue:
  - Development, demonstration and transition of signal processing algorithms designed to detect and classify acoustic signatures of threat submarines. Throughout the development process, algorithms will be transitioned to Naval Sea Systems Command under Program Element 0603561N (Advanced Submarine System Development), Project S0223 (Submarine Combat Systems Improvements).

- **High Frequency Broadband Transducer and Arrays for Submarines (Component of LASW FNC)**
  This effort has been terminated; final analysis and report documentation will be developed in order to capture and preserve the research progress to date for potential application to future system requirements.
  Complete:
  - Design and fabrication of prototype HF transducer array.
- **Limits of Passive Sonar**
  Continue:
  - Hardware component integration, testing and installation of an acoustic array testbed to support future passive sonar system designs.
  - Development of adaptive beamforming technology.
- **Counter Torpedo Detection, Classification, and Localization (DCL) (Component of LASW FNC)**

Initiate:
- Performance evaluation of a prototype end-to-end surface ship torpedo protection system against two torpedoes launched in quick succession.
- Integration of project products into the AN/WSQ-11 "Block II and III" system upgrades. Products will transition to PE 0603506N, Project F0225 (Surface Ship Torpedo Defense).

FY 2005 PLANS:

- **Sonar Automation (Component of LASW FNC)**
  Continue:
  - Development, demonstration and transition of signal processing algorithms designed to detect and classify acoustic signatures of threat submarines. Throughout the development process, algorithms will be transitioned to Naval Sea Systems Command under Program Element 0603561N (Advanced Submarine System Development), Project S0223 (Submarine Combat Systems Improvements).
- **Limits of Passive Sonar (Component of LASW FNC)**
  Initiate:
  - Focused research program to study the performance of sonar arrays with volumetric apertures using the acoustic array testbed.

  Continue:
  - Hardware component integration, testing and installation of an acoustic array testbed to support future passive sonar system designs.
  - Development of adaptive beamforming technology.
- **Counter Torpedo Detection, Classification, and Localization (DCL) (Component of LASW FNC)**
  Continue:
  - Performance evaluation of a prototype end-to-end surface ship torpedo protection system against two torpedoes launched in quick succession.
  - Integration of project products into the AN/WSQ-11 "Block II and III" system upgrades. Products will transition to PE 0603506N, Project F0225.

	FY02	FY03	FY04	FY05
Cooperative Anti-Submarine Warfare (ASW)	6,646	6,968	6,198	6,584

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 are developed under the heading of Integrated Anti-Submarine Warfare (IASW) in Program Elements (P.E.s) 0602235N and 0603235N. In this P.E., the focus of this activity is to demonstrate the operational utility of employing these IASW tools together with ASW sensor technologies developed as part of the Battlgroup 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; details are of a higher classification.

FY 2002 ACCOMPLISHMENTS:

- **Littoral Warfare Advanced Demonstration (LWAD) (Component of LASW FNC)**

  Continued:

  - LWAD scientific support, fleet and research vessel coordination, test reconstruction, logistical and environmental compliance support for three ASW, at-sea experiments involving multiple technologies. One experiment was conducted around the Continental United States(CONUS), overseas. The overseas experiments were collaborative with the Surface Warfare Development Group(SWDG), and the other collaborative with The Technical Cooperative Program (TTCP) with participation from the United Kingdom, Canada, New Zealand and Australia.

FY 2003 PLANS:

- **Littoral Warfare Advanced Demonstration (LWAD)**

  Continue:

  - LWAD test planning, scientific support, fleet and research vessel coordination, test reconstruction, logistical and environmental compliance support for two Littoral ASW (LASW) Future Naval Capability (FNC) initiatives, with one overseas experiment and one CONUS demonstration

FY 2004 PLANS:

- **Littoral Warfare Advanced Demonstration (LWAD)**

  Continue:

  - LWAD test planning, scientific support, fleet and research vessel coordination, test reconstruction, logistical and environmental compliance support for two LASW FNC CONUS at-sea experiments and one overseas demonstration in collaboration with TTCP and involving multiple acoustic and non-acoustic ASW technologies.

FY 2005 PLANS:

- **Littoral Warfare Advanced Demonstration (LWAD)**

  Continue:

  - LWAD test planning, scientific support, fleet and research vessel coordination, test reconstruction, logistical and environmental compliance support for one LASW FNC CONUS at-sea experiment and two overseas demonstrations involving multiple acoustic and non-acoustic ASW technologies.

	FY02	FY03	FY04	FY05
Neutralization	10,468	9,353	8,200	9,200

Effort includes:

- **Dynamic System Mechanics Advanced Simulation (DYSMAS) Full-Scale Modeling and Validation** - Part of the family of Coupled Eulerian-Lagrangian (CEL) hydrocodes that has the capability of modeling the interaction between underwater explosions and 3D naval structures including surfaced and submerged underwater vehicles. Effort addresses the adaptation, application and validation of DYSMAS explosion effects hydro-code and off-board sensors. This effort terminated in FY02.
- **Non-Traditional Homing (Component of LASW FNC)** addresses the demonstration of the operational utility of a stealthy torpedo detection, classification and homing sensor. This is a high risk development that holds promise for providing an improvement in probability of kill that is revolutionary.
- **Weapon/Platform Connectivity (Component of LASW FNC)** addresses development of technologies to enable a Heavyweight torpedo and a shooting platform to be effectively employed as a fully linked on-board and off-board sensor system.
- **SwampWorks Advanced Torpedo (SAT)** effort demonstrates technologies to meet emerging challenges of low Doppler, small targets (diesel submarines), in harsh littoral environments.

FY 2002 ACCOMPLISHMENTS:

- **DYSMAS Full-Scale Modeling and Validation**
  Terminated:
  - PE 0603747N effort terminated in FY02; DYSMAS hydro-code development effort continues in PE 0602747N (Neutralization)

- **Weapons Platform Connectivity**
  Continued:
  - Development of technologies to enable a Heavyweight torpedo and a shooting platform to be effectively employed as a fully linked on-board and off-board sensor system. Transitioned eight (8) hardware and software technologies to MK48 Common Broadband Active Sonar System (CBASS) acquisition program (PE 0205632N, Project F0366).

FY 2003 PLANS:

- **Weapons/Platform Connectivity**
  Continued:
  - Development of technologies to enable a Heavyweight torpedo and a shooting platform to be effectively employed as a fully linked on-board and off-board sensor system. Transition broadband signal processing and intelligent torpedo control algorithms (for improved performance) to MK-48 CBASS Program (PE 0205632N, Project F0366).
- **SwampWorks Advanced Torpedo (SAT)**

[1] Part of the family of Coupled Eulerian-Lagrangian (CEL) hydorcodes that has the capability of modeling the interaction between underwater explosions and 3D naval structures including surfaced and submerged underwater vehicles.

Initiate:
- Demonstration of the advanced half-length torpedo vehicle self noise, stability and control, and a proof-of-concept littoral upgrade to the Mk 48 advanced capability (ADCAP) sonar. Demonstration of a broadband recording system. Demonstration of technologies for a new rechargeable electric propulsion system for the SAT.

FY 2004 PLANS:

- **Non-Traditional Homing**
  Initiate:
  - Development of a non-traditional homing sensor system to provide a robust adjunct homing capability - including a technical assessment of the viability of integrating the sensor of choice into the MK48 Common Broadband Active Sonar System (MK48 CBASS).

- **Weapons/Platform Connectivity**
  Continue:
  - Development of technologies to enable a Heavyweight torpedo and a shooting platform to be effectively employed as a fully linked on-board and off-board sensor system.
- **SwampWorks Advanced Torpedo (SAT)**
  Continue:
  - Demonstration of the advanced half-length torpedo vehicle self noise, stability and control, and a proof-of-concept littoral upgrade to the Mk 48 advanced capability (ADCAP) sonar. Demonstration of a broadband recording system. Demonstration of technologies for a new rechargeable electric propulsion system for the SAT.

FY 2005 PLANS:

- **Non-Traditional Homing**
  Continue:
  - Development of a non-traditional homing sensor system to provide a robust adjunct homing capability - including initiating competitive design/manufacture of a sensor suitable for integrating into a MK48 torpedo size test vehicle.
- **Weapons/Platform Connectivity**
  Continue:
  - Development of technologies to enable a Heavyweight torpedo and a shooting platform to be effectively employed as a fully linked on-board and off-board sensor system. Transition broadband signal processing algorithms to NAVSEA 93 Advanced Systems Technology Office Advanced processing Build – Acoustic in P.E. 0603561N Project.
  Complete:

- In-water demonstration of an improved probability-of-kill (Pk) for close-in submarine-on-submarine engagements.

- **SwampWorks Advanced Torpedo (SAT)**
  Continue:
  - Demonstration of the advanced half-length torpedo vehicle self noise, stability and control, and a proof-of-concept littoral upgrade to the Mk 48 advanced capability (ADCAP) sonar. Demonstration of a broadband recording system. Demonstration of technologies for a new rechargeable electric propulsion system for the SAT.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY 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 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)

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603747N Project Number: R2916
PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology Project Title: Undersea Warfare Advanced Technology

D. ACQUISITION STRATEGY: Not Applicable

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

DATE: February 2003

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603747N Project Number: R2916
PROGRAM ELEMENT TITLE: Undersea Warfare Advanced Technology Project Title: Undersea Warfare Advanced Technology

Congressional Plus-Ups:

R2844/ Magnetrestrictive Transduction	FY02	FY03
	2,017	N/A

Conducted investigations into three cost reduction methods for the production of Terfenol-D (magnetorestictive, high-strain transducer materials). In the aggregate, these cost saving methods can potentially reduce the cost by as much as 90%.

R2846/Low Frequency Broadband Acoustic Airgun Source	FY02	FY03
	1,256	*

* Funded in FY03 in Project R9164

Developed a compact airgun source for use in detecting quiet submarines in shallow water and deployable from small platforms. Finalized the system design and conducted mechanical, electrical, and acoustic shakedown tests.

R9164/Motorized Airgun Program	FY02	FY03
	*	978

* Funded in FY02 in Project R2846.

The Motorized Airgun project will conduct an at-sea experiment of the design completed in FY-02, analyze the results and formulate a plan for transition.

R9165/University Oceanographic Laboratory System	FY02	FY03
	N/A	3,423

The University Oceanographic Laboratory System will provide support for research time at sea and to upgrade vessel research capabilities, as well as enhancements to ensure vessel operation reliability.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603757N
PROGRAM ELEMENT TITLE: Joint Warfare Experiments

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R3010 Joint Simulation System	0	0	13,684	14,292	13,231	12,047	10,969	9,790

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The mission of this program is to create a Software Support Facility (SSF) to support the delivery and maintenance of Block I of the Joint Simulation System (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).

U.S. Joint Forces Command’s (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.

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	0	0	0	0
Adjustments from FY 2003 President’s Budget:				
Joint Simulation System			14,000	14,600
Pay Raise/ Inflation Adjustments			-316	-308
FY 2004/2005 President’s Budget Submission:			13,684	14,292

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603757N Project Title: R3010/Joint Simulation System
PROGRAM ELEMENT TITLE: Joint Warfare Experiments

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R3010 Joint Simulation System	0	0	13,684	14,292	13,231	12,047	10,969	9,790

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U.S. Joint Forces Command's (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.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Joint Simulation System	0	0	13,684	14,292

Efforts include: software configuration management; joint exercise technical support; JSIMS specific training; resource repository maintenance; and software administrative support.

FY 2002 ACCOMPLISHMENTS:

- Not applicable

FY 2003 PLAN:

- Not applicable

FY 2004 PLAN:

- The JSIMS SSF will perform software configuration management (CM) which insures 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 PLAN:

- JWFC will continue software configuration management (CM) which insures 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.

C. OTHER PROGRAM FUNDING SUMMARY: Not applicable

NAVY RELATED RDT&E:
PE 060372N Joint Experimentation

D. ACQUISITION STRATEGY: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603758N
PROGRAM ELEMENT TITLE: Naval Warfighting Experiments and Demonstrations

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2918 Naval Warfighting Experiments and Demonstrations	46,024	42,501	20,584	17,992	42,493	44,542	45,388	46,268

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: Fleet Battle Experiments (FBE), Advanced Warfighting Experiments (AWE) 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. 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 (OEA). 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.

This program also completes the following Advanced Technology Demonstrations (ATDs): Reactive Material Advanced Warhead, Multi-Element Buoyant Cable Antenna, Multi-Platform Broadband Processing, and Forward Air Support Marine (FASM). ATD programs were selected for a match between technological potential and navy requirements, which were derived from operational issues of concern to the fleet. Risk-reducing ATDs covered integrating and assessing technology in a realistic operational environment and were focused on laying the technical foundations for acquiring improvements to future joint warfighting capabilities. Each demonstration was designed to assess the extent to which the technology is feasible, affordable, and compatible with operational concepts and projected force structure.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603758N
PROGRAM ELEMENT TITLE: Naval Warfighting Experiments and Demonstrations

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

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	42,827	43,460	44,275	43,307
Adjustments from FY 2003 President's Budget:				
S&T Reductions			-3,204	-3,227
Cong Recissions/Adjustments/Undist Reductions	-209	-498		
Execution Adjustments	+3,406			
NWCF Rate Adjustments			-71	+29
Efficiencies at NWCF Activities			-415	-417
S&T Program Adjustments			-19,526	-21,312
Pay Raise/Inflation Adjustments		-461	-475	-388
FY 2004/2005 President's Budget Submission:	46,024	42,501	20,584	17,992

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE:February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603758N Project Number: R2918
PROGRAM ELEMENT TITLE: Naval Warfighting Experiments and Demonstrations Project Title: Naval Warfighting Exp and Demo

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2918 Naval Warfighting Experiments and Demonstrations	46,024	42,501	20,584	17,992	42,493	44,542	45,388	46,268

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: Fleet Battle Experiments (FBE), Advanced Warfighting Experiments (AWE) 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. 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 (OEA). 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.

This project also completes the following Advanced Technology Demonstrations (ATDs): Reactive Material Advanced Warhead, Multi-Element Buoyant Cable Antenna, Multi-Platform Broadband Processing, and Forward Air Support Marine (FASM). ATD programs were selected for a match between technological potential and navy requirements, which were derived from operational issues of concern to the fleet. Risk-reducing ATDs covered integrating and assessing technology in a realistic operational environment and were focused on laying the technical foundations for acquiring improvements to future joint warfighting capabilities. Each demonstration was designed to assess the extent to which the technology is feasible, affordable, and compatible with operational concepts and projected force structure

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE:February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603758N Project Number: R2918
PROGRAM ELEMENT TITLE: Naval Warfighting Experiments and Demonstrations Project Title: Naval Warfighting Exp and Demo

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
High Speed Vessel (HSV) Experimentation and Demo	5,700	2,934	0	0

The Navy Warfare Development Command (NWDC), U.S. Army Combined Arms Support Command, Office of Naval Research (ONR), 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 2002 ACCOMPLISHMENTS:
The project developed the experimentation plan that incorporates all the research objectives from each of the services to include joint experimentation in Millennium Challenge 02 and consolidated the analytical talent to both build the experiments and analyze results among the Services. The experimentation phase was initiated using HSV-X1 as the test vessel under coordination by NWDC and in close partnership with other elements of the U.S. Navy, the U.S. Marine Corps, U.S. Army and U.S. Coast Guard. As a result of NSWC-Carderock's interim report on the seakeeping and structural assessment of HSV-X1, the need for additional dedicated sea trials was identified.

FY 2003 PLANS:
The project will continue the experimentation phase under coordination by NWDC with a refined test plan that adds NSWC-Carderock's recommended sea trials under test conditions that include: high sea state, low speed test runs to assess global structural loads, and moderate sea state, high speed test runs in longer period seaways to assess motion and slamming limits. The program will then complete the data base of test runs needed to fully quantify the operational profile of HSV-X1.

FY 2004 PLANS: Not applicable

FY 2005 PLANS: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE:February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: Naval Warfighting Experiments and Demonstrations

Project Number: R2918
Project Title: Naval Warfighting Exp and Demo

	FY 02	FY 03	FY 04	FY 05
FORCEnet - Expeditionary Sensor Grid (ESG) / Enabling Experimentation (EEE) / Knowledge Superiority and Assurance (KSA) Future Naval Capability (FNC)	7,783	16,625	*	*

* Effort transferred to Program Element 0603235N, Project R2919

This project takes the products of EEE and merges them with 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 2002 ACCOMPLISHMENTS:
The EEE project was initiated as provider of the underlying foundation that will enable concept-based operational, limited objective, and virtual experimentation to be conducted. A strategic Information Operations (IO) team was established consisting of N641 and elements of the DARPA IO Command and Control (IOC2) Dynamic Network Defense (DND) initiative. Development of a common methodology for sensor connectivity was initiated to facilitate a capability for Distributed Laboratory Experimentation and scoping analysis using each participating laboratories' contributions in their areas of excellence. Initial software items were delivered to operational experiments that permitted easy connection of heterogeneous elements that comprise an ESG, that allow for dynamic configuration and reconfiguration of an ESG and which provide the necessary information for dynamic command and control. ESG report generation and software delivery were accomplished successfully by using existing DARPA program technologies for agents such as Cooperating Agents for Specific Tasks (CAST), Control of Agent Based Systems (CoABS), and DARPA Agent Markup Language (DAML). Documentation and software were delivered that demonstrates how agent-based-computing (ABC) can provide dynamic and surgical defense of Fleet operational networks in response to information degradation, including cyber attacks. The results of Navy participation in the Joint Battle Center (JBC) Multi-Service Jini Experimentation were documented and demonstrated how the Jini network technology can discover information sources of other Services and integrate them

into a situational awareness Command and Control (C2) context for Fleet operational users over a widely distributed network. Software was further implemented during the FBE-J Coalition that demonstrated how agent environments, specifically CoABS can provide revolutionary advancements in Fleet operator situational awareness at the tactical level as well as revolutionary improvements in the warfighter's ability to conduct Command and Control in forward littoral regions that may be heavily contested.

FY 2003 PLANS:
Products of the FY02 EEE efforts will be combined with ongoing KSA FNC efforts to develop an integrated approach for FORCEnet experimentation. Demonstrations for dynamic strike and fires management will be planned based on contributions from KSA FNC efforts including enabling capabilities for Common Picture, Time Sensitive Decision Making, and Distributive Collaborative Planning and execution. EEE will complete the common methodology/connectivity technologies that facilitate a capability for Distributed Laboratory Experimentation, will increase the number of sensor types on the grid and will complete developmental work on an end-to-end capability enabled by the DARPA developed CoABS grid and agent based computing technologies. To assist information retrieval, sensor processing and data fusion will be 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 will be completed and testing of new capabilities continued in distributed laboratory experiments and during Fleet Battle Experiments. With evaluation by Fleet operational personnel, and a clear connection to FORCEnet, software implementations will be completed that demonstrate how agent-based-computing (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 will be 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 are expected to establish new capabilities that include: 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 will be 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.

FY 2004 PLANS:
Program continues in PE 0603235N, Project R2919

FY 2005 PLANS: Not Applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE:February 2003
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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603758N Project Number: R2918
PROGRAM ELEMENT TITLE: Naval Warfighting Experiments and Demonstrations Project Title: Naval Warfighting Exp and Demo

	FY 02	FY 03	FY 04	FY 05
Naval Warfare Experimentation Articles - Expeditionary Sensing Elements	9,597	17,564	15,584	12,992

This project matures technology and produces Operational Experimentation Articles (OEA) 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 2002 ACCOMPLISHMENTS:
Investigations were initiated on ESG concepts that envision thousands of additional sensors distributed across the battlespace of interest and placed in close proximity to the targets of interest as well as on previously unexploited phenomenology associated with targets distributed across the domains of space, air, sea, land, and information. Investigations of simple sensors and affectors were initiated in the context of platform centric acquisition programs. Efforts to develop Operational Experimentation Articles (OEA) which enable investigation of the feasibility and contribution of distributed sensors and affectors in littoral operations were initiated. Specific efforts that were initiated include: UAV-Borne Distributed Electro-Optical/Infrared Sensors which provide situational awareness of enemy firing positions and damage assessment from a low cost tactical UAV during clear and under the weather conditions; SWARM Distributed Micro-Affectors which defeat sophisticated enemy missile guidance radar sites; Distributed Undersea Warfare Pyramid Electromagnetic Sensors; and Unattended Sea-Based Cruise Missile Sensors. The Distributed Specific

Emitter Identifier (SEI) effort was initiated and completed in FY02 and culminated in a series of highly successful demonstrations during FBE-J as well as an immediate transition to operational usage aboard a deployed Navy vessel.

FY 2003 PLANS:
The project will continue to mature technologies and produce Operational Experimentation Articles (OEA) which enable investigation of the feasibility and contribution of distributed sensors and affectors in littoral operations. Exploration will continue 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 will include innovative and advanced technologies to reduce cost and risk and enable new operational concepts. Efforts will be completed that include: UAV-Borne Distributed Electro-Optical/Infrared Sensors; and SWARM Distributed Micro-Affectors. These completed efforts will demonstrate the capability to geo-locate mortar fire and the capability to defeat mobile ASM targeting radars in a distributed fashion with ESG-ready OEAs. Efforts that will be continued include: Distributed Undersea Warfare Pyramid Electromagnetic Sensors; and Unattended Sea-Based Cruise Missile Sensors. New OEA development efforts that will be initiated include: 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 Operational Experimentation Articles (OEA) 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 Operational Experimentation Articles (OEA) 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.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE:February 2003
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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603758N Project Number: R2918
PROGRAM ELEMENT TITLE: Naval Warfighting Experiments and Demonstrations Project Title: Naval Warfighting Exp and Demo

	FY 02	FY 03	FY 04	FY 05
U.S. Marine Corps Experimentation	2,000	3,911	3,500	3,500

This project provides support to experimental pathway events including Marine Corps service contribution to JFCOM's federated modeling and simulation efforts in support of experimentation.

FY 2002 ACCOMPLISHMENTS:
The project provided support to Millennium Challenge 02 experimental pathway events including Marine Corps service contribution to JFCOM's federated modeling and simulation efforts in support of experimentation. Support was also provided to JFCOM's spiral concept to develop an experimental Marine Expeditionary Brigade (MEB) command element capable of collaborating in near-real time using the modeling and simulation federation with the JFCOM experimental Standing Joint Force Headquarters (SJFHQ) during the Marine Corps role as Joint Land Component Commander.

FY 2003 PLANS:
The project will continue support to JFCOM's spiral concept development and distributed modeling and simulation experimentation. Support will be 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 SJFHQ that is the centerpiece of JFCOM 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 will be supported.

FY 2004 PLANS:
The project will continue supporting JFCOM's experimental pathways to include 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 integrating experiment in FY05. The program will support Marine Corps spiral development of Naval seabasing 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:
The project will continue supporting JFCOM's experimental pathways and spiral development leading to JFCOM's Pinnacle Challenge-05 experiment into the emerging Joint Warfighting Concept. The program will continue to support the Marine Corps contribution to the Joint Modeling and Simulation federation and an expanded Marine Corps involvement in the Joint Global War Game effort. Support will be provided to Marine Corps component collaborative planning tools required to adequately conduct distributed, seabased staff planning and execution in support of the nascent Joint Warfighting
Concept from an integrated, network centric naval seabase. Support will continue for Marine Corps JCDE coordination and implementation effort and future joint combat development capability assessments.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE:February 2003
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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: Naval Warfighting Experiments and Demonstrations

Project Number: R2918
Project Title: Naval Warfighting Exp and Demo

	FY 02	FY 03	FY 04	FY 05
Reactive Material Advanced Warhead Advanced Technology Demonstration (ATD)	5,200	0	0	0

This ATD is to utilize energetic fragments to enhance warhead effectiveness against missiles, aircraft and radar sites.

FY 2002 ACCOMPLISHMENTS:
The ATD was completed. Completed cylindrical full-scale explosive launch test series for Reactive Fragmentation Material and inclusion of results in lethality estimation programs. Conducted full-scale live explosive static testing of the Reactive Materials Enhanced Warhead against a number of targets, both real and simulated. This ATD completed the Reactive Warhead Critical Design review and submission of design package to transition agent, including systems design interface considerations. The ATD also completed Lethality Analysis and Toolset for Anti-Air Warfare (AAW) target set and transitioned to Engineering Manufacturing Development (EMD) Production program.

FY 2003 PLANS: Not Applicable

FY 2004 PLANS: Not Applicable

FY 2005 PLANS: Not Applicable

	FY 02	FY 03	FY 04	FY 05
Multi-Function Buoyant Cable Antenna ATD	4,500	0	0	0

This ATD is to develop and demonstrate an advanced Buoyant Cable Antenna (BCA) System to provide a submerged submarine with two-way, high- data rate Ultra High Frequency (UHF) fleet satellite communications, line-of-site (LOS) L-band, K-band communications as well as accessory sensor functions such as Global Positioning System, Video, and Radar Warning.

FY 2002 ACCOMPLISHMENTS:
The ATD was completed. This included completion of system fabrication and component testing, conducting surface based system tests using cable depressor and conducting a submarine demonstration.

FY 2003 PLANS: Not Applicable

FY 2004 PLANS: Not Applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE:February 2003
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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603758N Project Number: R2918
PROGRAM ELEMENT TITLE: Naval Warfighting Experiments and Demonstrations Project Title: Naval Warfighting Exp and Demo

FY 2005 PLANS: Not Applicable

	FY 02	FY 03	FY 04	FY 05
Multi-Platform Broad Band Processing ATD	4,600	0	0	0

This ATD is to develop and demonstrate common, broadband acoustic signal processing algorithms for submarine, surface ship, and weapons sonar systems.

FY 2002 ACCOMPLISHMENTS:
The ATD was completed. The performance of coherent broadband signal processing for submarine, surface ship and undersea weapon applications was demonstrated.

FY 2003 PLANS: Not Applicable

FY 2004 PLANS: Not Applicable

FY 2005 PLANS: Not Applicable

	FY 02	FY 03	FY 04	FY 05
Forward Air Support Marine ATD	6,644	0	0	0

This ATD is to demonstrate a gun launched observation vehicle with a 3 hour/240 nmi flight endurance and capabilities for surveillance, battle damage assessment, targeting and ordnance dispensing.

FY 2002 ACCOMPLISHMENTS:
The ATD was completed. This entailed completion of full-scale wind tunnel testing of the cruise vehicle, autonomous flights of the cruise vehicle and gun launch of a full-scale test vehicle.

FY 2003 PLANS: Not Applicable

FY 2004 PLANS: Not Applicable

FY 2005 PLANS: Not Applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE:February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603758N Project Number: R2918
PROGRAM ELEMENT TITLE: Naval Warfighting Experiments and Demonstrations Project Title: Naval Warfighting Exp and Demo

	FY 02	FY 03	FY 04	FY 05
Science and Technology Analysis and Assessments	0	1,467	1,500	1,500

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 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 2002 ACCOMPLISHMENTS: Not Applicable

FY 2003 PLANS:
Independent S&T reviews will be 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 Operational Experimentation Articles. Efforts will be focused on anti-access concepts under development by the Naval Warfare Development Command in the areas of Antisubmarine Warfare and Mine 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 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 Operational Experimentation Articles 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:
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 Operational Experimentation Articles 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 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE:February 2003
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BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603758N Project Number: R2918
PROGRAM ELEMENT TITLE: Naval Warfighting Experiments and Demonstrations Project Title: Naval Warfighting Exp and Demo

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
- PE 0601152N (In-house Lab 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 (Marine Corps Advanced Technology Demonstrations)
- PE 0603729N (Warfighter Protection Advanced Technology)
- PE 0603747N (Undersea Warfare Advanced Technology)
- PE 0603727N (Joint Experimentation)
- PE 0603782N (Mine & Expeditionary Warfare Advanced Technology)

NON-NAVY RELATED RDT&E:
- PE 0603750D (Advanced Concept Technology Demonstration)

D. ACQUISITION STRATEGY: Not Applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

COST: (Dollars in Thousands)

PROJECT NUMBER/ TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE	FY 2004 ESTIMATE	FY 2005 ESTIMATE	FY 2006 ESTIMATE	FY 2007 ESTIMATE	FY 2008 ESTIMATE	FY 2009 ESTIMATE
R2917 Mine and Expeditionary Warfare Advanced Technology	44,950	42,761	31,719	30,081	39,282	38,083	38,784	39,537
R2720 Ocean Modeling for Mine & Expeditionary Warfare	1,455	977						
R9166 Modeling the Warrior as a Cognitive System		1247						
Total	46,405	44,985	31,719	30,081	39,282	38,083	38,784	39,537

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program supports demonstrations of technologies for Naval Expeditionary Forces performing the missions of Mine and Expeditionary Warfare. The technologies support a range of capabilities particularly the Organic Mine Countermeasures Future Naval Capability (OMCM FNC) whose purpose is to provide the systems which can easily be deployed to any available afloat asset to clear and/or avoid an adversary minefield, enabling Naval Expeditionary Forces to influence operations ashore.

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

B. PROGRAM CHANGE SUMMARY:

	FY 2002	FY 2003	FY 2004	FY 2005
FY 2003 President's Budget Submission:	49,339	43,725	44,324	43,105
Congressional Plus-Ups	0	+2,275	0	0
Congressional Rescissions/Adjustments/Undist Reductions	-239	-526	0	0
SBIR Adjustment	-859			
Execution Adjustments	-1,836	0	0	0
NWCF Rate Adjustments			-557	-554
Pay Raise/Inflation Adjustments	0	-489	-670	-649
S&T Program Adjustments			-11,378	-11,821
FY 2004/2005 President's Budget Submission:	46,405	44,985	31,719	30,081

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2

BUDGET ACTIVITY: 3

PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

PROGRAM CHANGE SUMMARY EXPLANATION:

Schedule: Not applicable
Technical: Not applicable

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
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BUDGET ACTIVITY: 3 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 2002 ACTUAL	FY2003 ESTIMATE	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	44,950	42,761	31,719	30,081	39,282	38,083	38,784	39,537

A. 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, throughout the littoral battlespace. "Operation Desert Storm" demonstrated the requirement to counter the projected third world 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 to demonstrate improved MIW capabilities. The activities in this project are: (1) Surveillance and Reconnaissance; and (2) Breaching and Neutralization. These activities support 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.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 02	FY 03	FY 04	FY 05
Surveillance and Reconnaissance	26,018	21,962	17,553	20,182

The Surveillance and Reconnaissance activity focuses on developing and demonstrating technologies to detect, classify, and identify mines and obstacles throughout the Littoral Penetration Area. Efforts within this activity include: remote sensing techniques to survey threat mining activities and mine/obstacle field locations; advanced acoustic/non-acoustic sensors and processing technologies for rapid minefield reconnaissance and determination of the location of individual mines and obstacles. A major current focus is the development of technologies that provide rapid surveillance and reconnaissance, specifically in the very shallow water, surf zone, and beach zone (VSW,SZ,BZ), that support Ship to Objective Maneuver.

FY 2002 ACCOMPLISHMENTS:

- ADVANCED SURVEILLANCE/RECONNAISSANCE: Continued algorithm refinement efforts on critical environmental parameters, including offshore bathymetry, surface currents, and other essential elements of information for amphibious operations. Updated surveillance exploitation guide. Completed transition of Tier I algorithms for critical battlespace products to the Naval Oceanographic Office.

- MODELING AND SIMULATION: Continued simulation/visualization concept-based assessment of technologies for Future Naval Capabilities in organic Mine Countermeasures (MCM). Completed technology guideline study for mine countermeasures in support of ship to objective maneuver. Initiated system integration of technologies/concepts for mine countermeasures in support of ship to objective maneuver. Continued participation in Fleet Battle Laboratory experiments and expeditionary warfare wargaming. Developed initial prototype planning tool for expeditionary maneuver in a mined environment and provided it to amphibious squadrons for evaluation and feedback. Initiated development of visualization tool for amphibious assault craft to aid in staying in cleared lanes.

- VSW/SZ MINEHUNTING (formerly VSW/EOD Reconnaissance): Continued development of unmanned underwater vehicle (UUV) based optimized search strategies for very shallow water (VSW) reconnaissance. Continued development and demonstration of asset redirection and command redirection by radio frequency and underwater acoustic communication remote control. Continued demonstration of integrated search, marking, bathymetry-mapping threat objects and gaps and reports back in test-bed minefields in VSW environments. Continued demonstration of capability to enable diver teams to efficiently and accurately reacquire previously targeted areas and individual targets. Demonstrated VSW reconnaissance from a high-speed vessel during Fleet Battle Experiment Juliet. Transitioned autonomous underwater vehicle (AUV) technologies and Hydrographic Reconnaissance Littoral Mapping Device to Naval Sea Systems Command.

- ADVANCED AIRBORNE MINE DETECTION: Continued development of advanced electro-optic technologies for detection of near surface mines from a maritime unmanned airborne vehicle (UAV). Initiated development of automated mine/minefield detection and classification algorithms for active/passive electro-optic sensors. Continued development of multi-spectral laser for detection and targeting of minefields from a maritime UAV. Continued development of three-dimensional camera for detection and targeting of minefields.

- DATA FUSION: Initiated multi-platform, multi-sensor fusion of mine countermeasure sensor data. Initiated development and demonstration of a Common Tactical Picture to support expeditionary maneuver planning in a mined environment.

- FLEET DEMONSTRATIONS: Initiated planning for demonstration of mine countermeasures autonomous underwater vehicle (AUV) technologies during Fleet Battle Experiment Juliet (FBE (J)). Conducted Gulf of Mexico Limited Objective Experiment in preparation for FBE (J). Demonstrated deployment and operation of mine countermeasures AUV technologies from a high-speed vessel during FBE (J). Initiated planning for Transparent Hunter 2003 demonstration of mine countermeasure technologies in support of Ship To Objective Maneuver (STOM).

- VECTORED THRUST DUCTED PROPELLER (VTDP) COMPOUND HELICOPTER: Completed modifications to H-60 helicopter for flight testing of the VTDP. Completed pilot-in-the-loop verification of the VTDP flight control system. Continued flight test planning.

FY 2003 PLANS:

- ADVANCED SURVEILLANCE/RECONNAISSANCE: Continue Tier II algorithm refinement efforts on critical environmental parameters, including offshore bathymetry, surface currents, and other essential elements of information for amphibious operations. Optimize processing and data reduction tools for wide area detection of beach mined areas and obstacle belts. Initiate development of Tier III algorithms for critical environmental parameters. Demonstrate wide area detection of beach mined areas during Transparent Hunter 2003.

- MODELING AND SIMULATION: Complete development of visualization tool for amphibious assault craft to aid in staying in cleared lanes. Demonstrate visualization/navigation tool for amphibious assault craft lane keeping during Kernal Blitz 03 (Third Fleet Training Exercise). Continue simulation/visualization concept-based assessment of technologies for Future Naval Capabilities in organic MCM. Continue system integration of technologies/concepts for mine countermeasures in support of ship to objective maneuver. Continue participation in Fleet Battle Laboratory experiments and expeditionary warfare wargaming.

- VSW/SZ MINEHUNTING: Complete development of UUV based optimized search strategies for VSW reconnaissance. Continue demonstration of integrated 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 to efficiently and accurately reacquire previously targeted areas and individual targets. Demonstrate magneto-inductive firing device for remote triggering of neutralization charges. Demonstrate multi platform, coordinated VSW reconnaissance during FY03 Fleet Exercises.

- ADVANCED AIRBORNE MINE DETECTION: Continue development of advanced Electro-optic technologies for detection of near surface mines from a maritime unmanned airborne vehicle (UAV). Continue development of automated mine/minefield detection and classification algorithms for active/passive electro-optic sensors.

Complete development of multi-spectral laser for detection and targeting of minefields from a maritime UAV. Complete development of three-dimensional camera for detection and targeting of minefields. Initiate integration of multi—spectral laser and three-dimensional camera on a UAV testbed. Demonstrate night illumination techniques by using an Airborne Laser Diode Array Illuminator (ALDAI) in a COBRA-type mission, i.e. detection of land minefields from an airborne (Tactical UAV) platform.

- DATA FUSION: Continue multi-platform, multi-sensor fusion of mine countermeasures focusing on fusion of AV 15 kingfisher mode data for improved mine detection and avoidance. Continue improvements to AV 15 processing string. Initiate fusion of Nuclear Quadrapole Resonance (NQR) sensor with primary detection sensors to reduce false alarms.

- FLEET DEMONSTRATIONS: Complete documentation of FBE (J) exercise results. Complete the planning, then demonstrate mine countermeasures technologies in support of ship to objective maneuver during Transparent Hunter 03 (3^{rd} Fleet Exercise). Initiate analysis of Transparent Hunter exercise. Demonstrate integrated AUV minehunting operations from a Surface Mine Countermeasures Vehicle (SMCMV).

- VECTORED THRUST DUCTED PROPELLER (VTDP) COMPOUND HELICOPTER: Complete flight test planning.

FY 2004 PLANS:

- ADVANCED SURVEILLANCE/RECONNAISSANCE: Continue Tier III algorithm refinement efforts on critical environmental parameters, including offshore bathymetry, surface currents and other essential elements of information for amphibious operations. Complete transition of Tier II algorithms for critical battlespace products to the Naval Oceanographic Office and demonstrate operational integration.

- MODELING AND SIMULATION: Improve functionality of expeditionary warfare decision support software to include domain interpretation rules, active templates, and intelligent agents. Continue system integration of technologies/concepts for mine countermeasures in support of ship to objective maneuver. Continue participation in Fleet Battle Laboratory experiments and expeditionary warfare wargaming.

- VSW/SZ MINEHUNTING: Continue demonstration of integrated 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 to efficiently and accurately reacquire previously targeted areas and individual targets. Transition Diver Visual Interface System to Program Management Office, Explosive Ordnance Disposal (PMS-EOD). Integrate synthetic aperture sonar on VSW UUV system. Transition Search-Classify-Map UUV system to PMS-EOD. Transition acoustic micro-modem to NAVAL SEA SYSTEMS COMMAND product improvement program. Transition Computer Aided Detection, Computer Aided Classification System to NAVAL

SEA SYSTEMS COMMAND product improvement program. Transition Diver Charting and Graphical Display System to PMS-EOD. Develop demonstration of UUV target reacquisition with simulated neutralization. Demonstrate multi platform, coordinated VSW reconnaissance and reacquisition/identification during Fleet Exercises in FY04.

- ADVANCED AIRBORNE MINE DETECTION: Finalize development and testing of Rapid Overt Airborne Reconnaissance (ROAR) system for automated mine/minefield/obstacle detection in the VSW, SZ and BZ - using a scanning laser with a 3-D receiver for VSW and SZ capability and the multi-spectral capability for land-based detection in the BZ. Initiate a Broad Agency Announcement for advanced development for airborne buried minefield detection for over the beach, inward to the Beach Exit Zone.

- DATA FUSION: Continue multi-platform, multi-sensor fusion of mine countermeasure sensor data. Continue development of multi-platform fusion of AV 15 Kingfisher mode data for improved mine detection and avoidance. Continue improvements to AV 15 processing string for mine detection and avoidance. Initiate development of fusion between AV 15 detections and those from high-resolution mine hunting systems (e.g. AN/AQS-20).

- FLEET DEMONSTRATIONS: Complete documentation of FY03 technology demonstrations' results. Initiate planning for demonstration of mine countermeasures technologies during FY04 fleet training exercises and experiments of opportunity.

FY 2005 PLANS:

- ADVANCED SURVEILLANCE/RECONNAISSANCE: Complete development and transition of Tier III algorithms for critical battlespace products to the Naval Oceanographic Office and demonstrate operational integration.

- MODELING AND SIMULATION: Continue system integration of technologies/concepts for mine countermeasures in support of ship to objective maneuver. Continue participation in Fleet Battle Laboratory experiments and expeditionary warfare wargaming.

- VSW/SZ MINEHUNTING: Continue demonstration of integrated 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 to efficiently and accurately reacquire previously targeted areas and individual targets. Perform field evaluation of synthetic aperture sonar on UUV. Demonstrate UUV target reacquisition with simulated neutralization in Fleet Exercise.

- ADVANCED AIRBORNE MINE DETECTION: Demonstrate full capability to detect mines, mine lines, and minefields during a fleet exercise with the Rapid Overt Airborne Reconnaissance (ROAR) system.

- DATA FUSION: Continue multi-platform, multi-sensor fusion of mine countermeasure sensor data. Continue development of multi-platform fusion of AV 15 Kingfisher mode data for improved mine detection and avoidance. Continue improvements to AV 15 processing string for mine detection and avoidance. Continue development of fusion between AV 15 detections and those from high-resolution mine hunting systems (e.g. AN/AQS-20). Initiate development of multi-sensor fusion of Long-Term Mine Reconnaissance System (LMRS) sensors with other high-resolution mine hunting sensors and AV 15 data. Continue development and demonstration of a Common Tactical Picture to support expeditionary maneuver planning in a mined environment.

- FLEET DEMONSTRATIONS: Complete documentation of FY04 exercise results. Continue planning for near term demonstrations of mine countermeasure technologies in support of ship to objective maneuver. Demonstrate mine countermeasure technologies in support of ship to objective maneuver during fleet training and readiness exercises and experiments.

	FY 02	FY 03	FY 04	FY 05
Breaching and Neutralization	18,932	20,799	14,166	9,899

The Breaching and Neutralization activity focuses on developing and demonstrating technologies for stand-off breaching of mines and obstacles in the surf and beach zones and precision neutralization of individual sea mines. Research areas within this activity include: influence sweeping technologies for influence minefield clearance, explosive and non-explosive technologies for mine/obstacle field breaching, and advanced technologies to rapidly neutralize near-surface sea mines. A major current focus is the development of technologies that provide rapid detection and standoff breaching of mines and obstacles, specifically in the very shallow water/surf zone/beach zone (VSW/SZ/BZ) that enable Ship to Objective Maneuver.

FY 2002 ACCOMPLISHMENTS:

- SZ NEUTRALIZATION OF MINES AND OBSTACLES: Continued development of chemical and reactive darts for neutralization of beach and surf zone mines. Continued development of dispensing technologies for distributing reactive and chemical darts. Continued testing of chemical dart lethality against representative beach zone mines. Initiated demonstration of dart lethality against representative surf zone mines. Initiated integration of chemical and reactive dart warhead payload and delivery platform for

system levels demonstration.

- BZ NEUTRALIZATION OF OBSTACLES: Continued development of air delivered, continuous rod warhead for neutralization of beach obstacles.

- ORGANIC MINEHUNTING AND NEUTRALIZATION OF MINES: Initiated a broad area announcement (BAA) for the development and demonstration of mine countermeasures mission packages from an unmanned surface vehicle (USV). Initiated unmanned surface vehicle tow body motion measurements and analysis.

FY 2003 PLANS:

- SZ NEUTRALIZATION OF MINES AND OBSTACLES: Continue development of chemical and reactive darts for neutralization of beach and surf zone mines. Continue development of dispensing technologies for distributing reactive and chemical darts. Complete demonstration of chemical and reactive dart lethality against representative surf zone mines. Begin integration of chemical dart warhead payload and delivery platforms for system level demonstration. Initiate development of a system concept employing guided bombs for SZ neutralization. Begin advanced development of assault lane navigation system.

- BZ NEUTRALIZATION OF OBSTACLES: Continue development of air delivered, continuous rod warhead for neutralization of beach obstacles. Initiate development of a system concept for BZ neutralization.

- ORGANIC MINEHUNTING AND NEUTRALIZATION OF MINES: Initiate development of minesweeping mission package technologies and begin integration onto an Unmanned Surface Vehicle. Complete Unmanned Surface Vehicle tow body motion measurement and analysis.

FY 2004 PLANS:

- SZ NEUTRALIZATION OF MINES AND OBSTACLES: Complete development of chemical and reactive darts for neutralization of beach and surf zone mines. Continue development of dispensing technologies and integration of chemical and reactive dart warhead payload and delivery platforms for system level demonstrations. Continue development of a system concept employing guided bombs for SZ neutralization of mines and obstacles.

- BZ NEUTRALIZATION OF OBSTACLES: Continue development of air delivered, continuous rod warhead and integration onto delivery platforms for system level demonstrations. Continue development of system concept employing guided bombs for BZ neutralization.

- ORGANIC MINEHUNTING AND NEUTRALIZATION OF MINES: Complete development and integration of mine sweeping mission package on an Unmanned Surface Vehicle. Begin experimentation of autonomous mine sweeping operations from a High Speed Vessel (HSV) during a fleet training exercise or fleet battle experiment.

FY 2005 PLANS:

- SZ NEUTRALIZATION OF MINES AND OBSTACLES: Complete development of dispensing technologies and integration of chemical and reactive dart warhead payload and delivery platforms for system level demonstrations. Demonstrate a system concept employing guided bombs for SZ neutralization of mines and obstacles.

- BZ NEUTRALIZATION OF OBSTACLES: Complete development of air delivered, continuous rod warhead for neutralization of beach obstacles. Continue integration of the continuous rod warhead and delivery platforms for system level demonstrations. Demonstrate a system concept employing guided bombs for BZ neutralization of mines and obstacles.

- ORGANIC MINEHUNTING AND NEUTRALIZATION OF MINES: Initiate development of minehunting mission package on an Unmanned Surface Vehicle. Continue experimentation of autonomous mine sweeping operations from a High Speed Vessel (HSV) during a fleet training exercise or fleet battle experiment focusing on multiple Unmanned Surface Vehicle operations (with supervision).

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0601153N (Defense Research Sciences)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602747N (Undersea Warfare Applied Research)
PE 0602782N (Mine and Expeditionary Warfare Applied Research)
PE 0602435N (Ocean Warfighting Environment Applied Research)
PE 0603502N (Surface and Shallow Water Mine Countermeasures)
PE 0603513N (Shipboard System Component Development)
PE 0603640M (Marine Corps Advanced Technology Demo)
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)

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology

Project Number: R2917
Project Title: Mine and Expeditionary Warfare Advanced Technology

D. ACQUISITION STRATEGY: Not applicable.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003
Exhibit R-2a

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603782N Project Number: Various
PROGRAM ELEMENT TITLE: Mine and Expeditionary Warfare Advanced Technology Project Title: Congressional Plus-ups

Congressional Plus-Ups:

R2720	FY 02	FY 03
Ocean Modeling for Mine & Expeditionary Warfare	1,455	977

The objective of this effort is to continue maintenance of an ocean observational and data management system for the Gulf of Maine and to demonstrate the exploitation of a common environment for enhancing expeditionary operations in a mined environment.

R9166	FY 02	FY 03
Modeling the Warrior as a Cognitive System	0	1,247

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.

FY 2004/2005 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: February 2003

BUDGET ACTIVITY: 3 PROGRAM ELEMENT: 0603792N
PROGRAM ELEMENT TITLE: Advanced Technology Transition

PROJECT NUMBER & TITLE	FY 2002 ACTUAL	FY 2003 ESTIMATE
	*0	2,445
R9167 Man-Portable Quadrupole Resonance Landmine Detection Program		
TOTAL	*0	2,445

*This Program Element (PE) was restructured in FY 2002.

The FY 2003 Congressional Plus-up appropriated in this PE is described in PE 0603640M.