DEPARTMENT OF THE NAVY
FISCAL YEAR (FY) 2006/FY 2007
BUDGET ESTIMATES

JUSTIFICATION OF ESTIMATES
FEBRUARY 2005

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

DEPARTMENT OF THE NAVY

FY 2006 RDT&E PROGRAM

SUMMARY
($ IN THOUSANDS)

FEBRUARY 2005

Summary Recap of Budget Activities	FY 2004	FY 2005	FY 2006
Basic Research	468,358	491,126	448,295
Total Research, Development, Test & Eval, Navy	468,358	491,126	448,295

Summary Recap of FYDP Programs			
Research and Development	468,358	491,126	448,295
Total Research, Development, Test & Eval, Navy	468,358	491,126	448,295

DEPARTMENT OF THE NAVY
FY 2006 RDT&E PROGRAM

EXHIBIT R-1

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

Date: FEBRUARY 2005

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2004	FY 2005	FY 2006	SEC
1	0601103N	University Research Initiatives	01	88,921	91,310	75,910	U
2	0601152N	In-House Laboratory Independent Research	01	15,194	19,375	15,500	U
3	0601153N	Defense Research Sciences	01	364,243	380,441	356,885	U
	Basic Research			468,358	491,126	448,295	
	Total Research, Development, Test & Eval, Navy			468,358	491,126	448,295	

DEPARTMENT OF THE NAVY

FY 2006 RDT&E PROGRAM

SUMMARY
($ IN THOUSANDS)

FEBRUARY 2005

Summary Recap of Budget Activities	FY 2004	FY 2005	FY 2006
Applied Research	677,729	822,425	597,914
Total Research, Development, Test & Eval, Navy	677,729	822,425	597,914

Summary Recap of FYDP Programs			
Research and Development	677,729	822,425	597,914
Total Research, Development, Test & Eval, Navy	677,729	822,425	597,914

DEPARTMENT OF THE NAVY
FY 2006 RDT&E PROGRAM

EXHIBIT R-1

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

Date: FEBRUARY 2005

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2004	FY 2005	FY 2006	SEC
4	0602114N	Power Projection Applied Research	02	141,450	135,163	94,148	U
5	0602123N	Force Protection Applied Research	02	104,801	143,652	101,650	U
6	0602131M	Marine Corps Landing Force Technology	02	29,541	37,036	37,590	U
7	0602233N	Human Systems Technology	02	1,660	1,485		U
8	0602234N	Materials, Electronics and Computer Technology	02	1,730	3,962		U
9	0602235N	Common Picture Applied Research	02	87,928	102,107	57,693	U
10	0602236N	Warfighter Sustainment Applied Research	02	91,808	131,030	82,856	U
11	0602271N	RF Systems Applied Research	02	48,462	64,640	47,302	U
12	0602435N	Ocean Warfighting Environment Applied Research	02	56,789	69,601	49,793	U
13	0602651M	Joint Non-Lethal Weapons Applied Research	02		1,880	6,000	U
14	0602747N	Undersea Warfare Applied Research	02	69,923	84,325	71,362	U
15	0602782N	Mine and Expeditionary Warfare Applied Research	02	43,637	47,544	49,520	U
		Applied Research		677,729	822,425	597,914	
		Total Research, Development, Test & Eval, Navy		677,729	822,425	597,914	

DEPARTMENT OF THE NAVY

FY 2006 RDT&E PROGRAM

SUMMARY
($ IN THOUSANDS)

FEBRUARY 2005

Summary Recap of Budget Activities	FY 2004	FY 2005	FY 2006
Advanced Technology Development	1,036,196	975,003	729,852
Total Research, Development, Test & Eval, Navy	1,036,196	975,003	729,852

Summary Recap of FYDP Programs			
Research and Development	1,036,196	975,003	729,852
Total Research, Development, Test & Eval, Navy	1,036,196	975,003	729,852

DEPARTMENT OF THE NAVY
FY 2006 RDT&E PROGRAM

EXHIBIT R-1

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

Date: FEBRUARY 2005

Line No	Program Element Number	Item	Act	Thousands of Dollars FY 2004	FY 2005	FY 2006	SEC
16	0603114N	Power Projection Advanced Technology	03	229,851	135,758	82,538	U
17	0603123N	Force Protection Advanced Technology	03	128,088	180,641	71,488	U
18	0603235N	Common Picture Advanced Technology	03	83,556	83,062	60,589	U
19	0603236N	Warfighter Sustainment Advanced Technology	03	87,281	91,665	68,540	U
20	0603271N	RF Systems Advanced Technology	03	60,933	71,743	75,070	U
21	0603640M	USMC Advanced Technology Demonstration (ATD)	03	98,595	88,239	56,434	U
22	0603651M	Joint Non-Lethal Weapons Technology Development	03		5,809	2,394	U
23	0603706N	Medical Development	03	26,969			U
24	0603727N	Navy Technical Information Presentation System	03	133,476	167,107	187,943	U
25	0603729N	Warfighter Protection Advanced Technology	03	29,183	66,868	16,068	U
26	0603747N	Undersea Warfare Advanced Technology	03	52,895	33,087	27,603	U
27	0603757N	Joint Warfare Experiments	03	19,440	26		U
28	0603758N	Navy Warfighting Experiments and Demonstrations	03	44,690	15,743	49,288	U
29	0603782N	Mine and Expeditionary Warfare Advanced Technology	03	41,239	35,255	31,897	U
		Advanced Technology Development		1,036,196	975,003	729,852	
		Total Research, Development, Test & Eval, Navy		1,036,196	975,003	729,852	

Fiscal Year 2006 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, **[**$17,043,812,000**]** *$18,037,991,000*, to remain available for obligation until September 30, **[**2006**]** *2007*: *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, 2005.)*

Program: *Basic Research*

Rating: *Effective*

Program Type: *Research and Development*

Agency: *Department of Defense--Military*

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

Last Assessed: *2 years ago*

Key Performance Measures from Latest PART	***Year***	***Target***	***Actual***
Annual Measure: 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&later	100%	100%
Annual Measure: 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%	

Recommended Follow-up Actions	***Status***
Continue to emphasize the use of independent review panels in assessing the performance of the program.	Completed
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.	Action taken, but not completed

Update on Follow-up Actions:

Program Funding Level (in millions of dollars)

2004 Actual	**2005 Estimate**	**2006 Estimate**
1,358	1,513	1,319

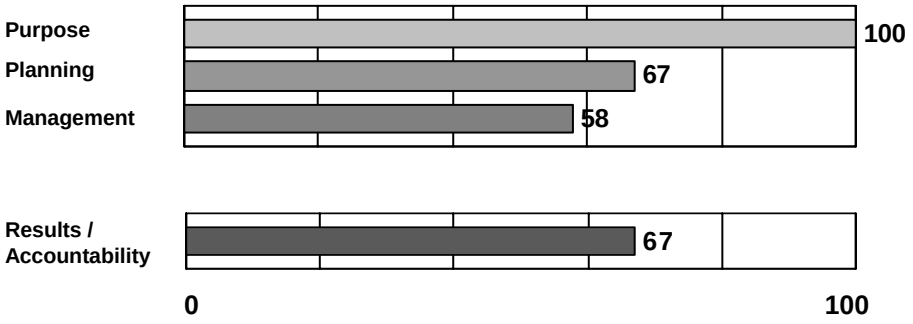
Program: *DoD Applied Research Program*

Rating: *Moderately Effective*

Agency: *Department of Defense--Military*

Bureau:

Program Type: *Research and Development*



Program Summary:

The Department of Defense's Applied Research program supports systematic, scientific study to gain understanding necessary to determine how the Department's military mission can be accomplished more effectively or more efficiently. Applied research often takes the results of basic research investments and carries them forward to determine the operational parameters of potential technologies and evaluate the practicality of applying those technologies to military needs.

The assessment of the Applied Research program found that:

- The program purpose and design are clear. The Department has built methodical processes for setting program goals and for reviewing progress. The program is designed to ensure that warfighters have superior and affordable technology to support their missions and to provide revolutionary war-winning capabilities.
- Reviews of the program by external review panels are not independent of program officials.
- A large part of the program is executed either without the benefit of military or scientific expertise in choosing the funded work or without allowing the applications process to be open to all capable researchers. Earmarking of projects in the program has increased in the recent past and has led to these problems.

In response to these findings, the Administration will:

1. Continue to ensure that adequate funding exists to carry promising basic research results into the realm of applied research.
2. Change the expert evaluation process to use fully independent review panels in assessing the performance of the program.
3. 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.

Key Performance Measures from Latest PART	***Year***	***Target***	***Actual***
Long-term Efficiency Measure: Reduce by half within three years, grant and contract award funding not (1) resulting from needs identified by military or technical experts within the Services or Agencies and (2) awarded through the merit-review process. Currently about $1.0 B/yr.	2006	<$800 M	
	2007	<$500 M	
	2008	<$500 M	
Annual Measure: Percentage of ambitiously chosen Defense Technology Objectives (DTO) targets achieved.	2005	70%	
	2006	70%	
	2007	70%	
	2008	70%	
Annual Measure: Portion of external technology area review panels that are fully independent (all external reviewers).	2006	100%	
	2007	100%	
	2008	100%	

Program Funding Level (in millions of dollars)

2004 Actual	**2005 Estimate**	**2006 Estimate**
4,350	4,850	4,139

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N
PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
UNIVERSITY RESEARCH INITIATIVES	88,921	91,310	75,910	72,905	75,655	77,087	78,703	80,354

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

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

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N
PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	91,489	83,508	75,980	72,963
Cong Rescissions/Adjustments/Undist. Reductions	0	-879	0	0
Congressional Action	0	8,700	0	0
Non-Pay Inflation Adjustments	-85	0	0	0
Program Adjustments	0	-19	-70	-58
SBIR Assessment	-2,483	0	0	0
FY 2006/2007 President's Budget Submission	88,921	91,310	75,910	72,905

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
UNIVERSITY RESEARCH INITIATIVES	88,921	91,310	75,910	72,905	75,655	77,087	78,703	80,354

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

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
MULTIDISCIPLINARY UNIVERSITY RESEARCH INITIATIVE (MURI)	48,788	58,466	58,156	46,991

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

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

Battlespace Awareness, Electric Power Sources for the Navy and Marine Corps, Naval Materials by Design, and Multifunctional Electronics for Intelligent Naval Sensors).

Fluctuations in the program value between fiscal years reflect the maturation of existing awards. MURIs are a 3-year grant award, with a 2-year executable option. The FY 2007 budget reflects the FY 2004 budget that contained only 6 FY04 new MURI awards, generating fewer out-year bills from MURI efforts. New awards in FY 2006 and FY 2007 will be kept at approximately 10-14 new awards, engaging the academic community robustly in basic research.

FY 2004 Accomplishments:

• A Broad Agency Announcement (BAA) was used to solicit proposals addressing five ONR high priority topics. Six research grants were awarded in response to proposals for the five ONR topics, and one grant was awarded in response to a proposal addressing the OSD topic of Laboratory Instrumentation Design. These awards were in the priority research areas of semiconductor materials, environmental modeling and prediction, electromagnetic launchers, missile propulsion technology, combat warrior survival, and power systems test and measurement. New MURI awards totaled $5,396K in FY 2004. $43,392K was spent to continue MURI projects begun in prior years.

FY 2005 Plans:

• Conduct competition for $5,500K of new MURI awards to address selected high priority Naval science and technology areas, transformational initiatives, and grand challenges, including strategically important DoD research areas. Ten topics have been identified for publication in a BAA to solicit proposals. These topics address interferometry, dielectric materials, materials processing, wavefield prediction, nanostructured materials, semiconductors for radio frequency sensors, river and estuarine flows, magnetic sensors, hypersonic materials, and machine language. $52,966K will be spent to continue MURI projects begun in prior years.

FY 2006 Plans:

• Conduct competition for $5,500K of new MURI awards to address selected high priority Naval science and technology areas, transformational initiatives, and grand challenges, including strategically important DoD research areas. About ten high priority research topics will be identified for publication in a BAA to solicit proposals. $52,656K will be spent to continue MURI projects begun in prior years.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

FY 2007 Plans:

• Conduct competition for $7,700K of new MURI awards to address selected high priority Naval science and technology areas, transformational initiatives, and grand challenges, including strategically important DoD research areas. About fourteen high priority research topics will be identified for publication in a BAA to solicit proposals. $39,291K will be spent to continue MURI projects begun in prior years.

	FY 2004	FY 2005	FY 2006	FY 2007
DEFENSE UNIVERSITY RESEARCH INSTRUMENTATION PROGRAM	18,123	17,186	16,705	24,865

Defense University Research Instrumentation Program (DURIP) funds are provided to universities to purchase relatively high cost research instrumentation that is normally not included in single-investigator type research grants. Individual grants range from $50,000 to $1,000,000, with awards averaging about $200,000.

FY 2005 Congressional program cut reduces competition from approximately 90 research instrumentation awards down to 72. FY 2006 and FY 2007 funding levels remain at approximately the same level as previous submission. This level of effort restores the DURIP program to previous levels and will provide robust support to on-going efforts. In addition, DURIP supports the DON overall corporate goal of continuing to emphasize the value and importance of basic research contributions. Restoring DURIP levels in FY 2007 represents the best value to the DON, when combined with the effort to increase anticipated MURI awards from 6 in FY 2004 to 14 in FY 2007.

FY 2004 Accomplishments:

• In response to the FY 2004 DURIP Broad Agency Announcement, 375 proposals requesting more than $100 million were submitted to ONR. Seventy six of these proposals were selected for an award.

FY 2005 Plans:

• Conduct competition for approximately 72 research instrumentation awards to universities.

FY 2006 Plans:

• Conduct competition for approximately 65 research instrumentation awards to universities.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

FY 2007 Plans:

- Conduct competition for approximately 95 research instrumentation awards to universities.

	FY 2004	FY 2005	FY 2006	FY 2007
PRESIDENTIAL EARLY CAREER AWARDS	1,000	1,100	1,049	1,049

Extremely prestigious, presidential-rank, single-investigator research awards in areas of importance to the Department of the Navy, to recognize and encourage outstanding academic scientists and engineers early in their research career. Presidential Early Career Awards for Scientists and Engineers (PECASE) awards are made by research agencies throughout the federal government. Awards provide national recognition and research grants of $100,000 per year for five years.

FY 2004 Accomplishments:

- Two outstanding university researchers were selected to receive the five-year PECASE research award to conduct research of importance to the Navy. Continued 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.

FY 2006 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 2007 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.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
ARMED FORCES FOOD SAFETY AND SECURITY RESEARCH	2,691	0

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

	FY 2004	FY 2005
CENTER FOR MARITIME SYSTEMS	3,460	0

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

	FY 2004	FY 2005
CENTER FOR MICROWAVE FERRITES AND MULTI-FUNCTIONAL INTEGRATED CIRCUITS	0	990

This effort supports basic research at the Center for Microwave Ferrites and Multi-functional Integrated Circuits.

	FY 2004	FY 2005
CENTER FOR SOUTHEASTERN TROPICAL ADVANCED REMOTE SENSING (CSTARS)	4,805	2,476

FY04: This effort developed a ground station to receive remote sensing data from commercial satellites to enhance the intelligence, surveillance, and reconnaissance mission of US SouthCom.
FY05: This effort supports scientific research in land, atmosphere, ice and ocean sciences, as well as more practical applications in the fields of environmental monitoring, natural hazard assessment, civil defense and defense tactical applications at the Center for Southeastern Tropical Advanced Remote Sensing.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

	FY 2004	FY 2005
DEFENSE COMMERCIALIZATION RESEARCH INITIATIVE	0	3,962

This effort supports the Defense Commercialization Research Initiative.

	FY 2004	FY 2005
LOW TEMPERATURE RESEARCH CENTER	961	0

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

	FY 2004	FY 2005
MEMS SENSOR FOR ROLLING ELEMENT BEARINGS	1,394	0

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

	FY 2004	FY 2005
MULTIFUNCTIONAL MATERIALS FOR NAVAL STRUCTURES	0	1,585

This effort supports development of multifunctional materials for Naval structures.

	FY 2004	FY 2005
NANOMATERIALS FOR HIGH PERFORMANCE COATING APPLICATIONS	964	0

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

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
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	FY 2004	FY 2005
NANOPARTICLE MATERIALS RESEARCH	0	1,090

This effort supports nanoparticle materials research.

	FY 2004	FY 2005
NANOSCIENCE RESEARCH	2,890	1,485

FY04: This effort developed new concepts for improved materials, novel structures, and integrated, multifunctional materials and structures with potential dual use applications for homeland security.
FY05: This effort supports nanoscience research to overcome limitations that inhibit the fulfillment of nanomaterials' potential for widespread use in naval structures and sensors with potential dual use applications for homeland security.

	FY 2004	FY 2005
NATIONAL SECURITY TRAINING	0	990

This effort supports national security training.

	FY 2004	FY 2005
NEURAL ENGINEERING RESEARCH	961	990

FY04: This effort supported basic research in the area of human neural networks by employing microscale devices that allow real-time analyses of human brain nerve signals. This effort explored the feasibility of humans controlling autonomous devices via brain activity.
FY05: This effort supports neural engineering research.

	FY 2004	FY 2005
REMOTE SENSING RESEARCH	0	990

This effort supports remote sensing research.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601103N PROGRAM ELEMENT TITLE: UNIVERSITY RESEARCH INITIATIVES
PROJECT TITLE: UNIVERSITY RESEARCH INITIATIVES

	FY 2004	FY 2005
SURA COASTAL OCEAN OBSERVATION PROGRAM (SCOOP)	2,884	0

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

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	15,194	19,375	15,500	15,951	16,521	16,957	18,018	18,474

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) accomplishes the following: (a) sustains U.S. Naval Science and Technology (S&T) superiority by providing new technological concepts for the maintenance of naval power and national security and by 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 and is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command and the Marine Corps Combat Development Command. It 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, Studies, and Technology Organization, and the Bureau of Medicine and Surgery laboratories. The 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 twenty-two 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;

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

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; developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to Naval problems; promoting hiring and development of new scientists; and encouragement of 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 comprised of 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. The trend continued in FY04. ILIR status, results, and management are reported annually to the Deputy Under-Secretary of Defense (S&T).

ILIR projects are selected by Center/Lab COs and TDs near the start of each Fiscal Year through internal competition. Projects typically last three 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 FY04, about fifty projects were completed and seventy were initiated.

Support for the basic medical research at USUHS provides the only programmed research funds received by the University. In addition, it facilitates the recruitment and retention of faculty; supports unique research training for military medical students and resident fellows; and allows the University’s faculty researchers to collect pilot data in order to secure research funds from extramural sources (estimated $35 million annually). Eighty to one hundred intramural medical research projects are active each year, including twenty to twenty-five 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 S&T programs. They are designed to answer fundamental questions of

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

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).

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

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N
PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	17,196	17,664	17,891	18,178
Cong Rescissions/Adjustments/Undist. Reductions	0	-185	0	0
Congressional Action	0	1,900	0	0
Execution Adjustments	-1,860	0	0	0
Non-Pay Inflation Adjustments	-16	0	0	0
Transfer of USUHS to the Defense Health Prog	0	0	-2,379	-2,424
Program Adjustments	0	-4	-17	-14
Rate Adjustments	0	0	5	211
SBIR Assessment	-126	0	0	0
FY 2006/2007 President's Budget Submission	15,194	19,375	15,500	15,951

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Transfer In-house Laboratory Independent Research (ILIR) (RDT&E,N PE 0601152N) Funding and Requirements for Uniformed Services University of the Health Sciences (USUHS)to the Defense Health Program (DHP) in FY 2006 and FY 2007.

Schedule: Not applicable.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	15,194	19,375	15,500	15,951	16,521	16,957	18,018	18,474

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project sustains U.S. Naval 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 DON Integrated Warfare Architecture Requirements for long term Navy and Marine Corps improvements. It 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 ONR and executed by the COs and TDs of the Naval Warfare Centers, Naval Personnel Research, Studies, and Technology Organization, Bureau of Medicine and Surgery laboratories and USUHS.

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 NRL.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
OCEAN/SPACE SCIENCES	3,396	4,024	3,565	3,669

FY 2004 Accomplishments:

• Identified and studied species of graywater bacteria that are important to the efficient operation of graywater membrane bio-reactor treatment systems.
• Began development of a vaccine that would protect against one of the major causes of bacterial diarrhea world wide.
• Applied inverse methods to experimental underwater sound data to understand when three dimensional propagation effects are important and investigated a computationally efficient method for estimating the range and depth of a sound source.
• Completed knowledge supporting development of a vaccine to protect Navy working marine mammals.

FY 2005 Plans:

Continue all efforts of FY04 less those noted as completed above.
• Completed development of a vaccine that would protect against one of the major causes of bacterial diarrhea world wide.

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY05 will focus on supporting the ONR Grand Challenge in Naval Battlespace Awareness, Innovative Naval Prototypes initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility Initiatives in Ocean Acoustics and Undersea Weaponry.

FY 2006 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting the ONR Grand Challenge in Naval Battlespace Awareness, Innovative Naval Prototypes initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility Initiatives in Ocean Acoustics and Undersea Weaponry.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting the ONR Grand Challenge in Naval Battlespace Awareness, Innovative Naval Prototypes initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility Initiatives in Ocean Acoustics and Undersea Weaponry.

	FY 2004	FY 2005	FY 2006	FY 2007
ADVANCED MATERIALS	2,604	2,974	2,635	2,711

FY 2004 Accomplishments:

• Completed development of amorphous steel compositions and subsequently predicted their nucleation and growth of grains into devitrified nano-composite steel.
• Completed development of 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.
• Researched polymers with ‘self healing’ properties for use in fuel tanks.
• Completed investigation of the effect of external environmental stimuli on the mechanisms that cause coating system degradation in naval aircraft.

FY 2005 Plans:

Continue all efforts of FY04 less those noted as completed above.

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY05 will focus on supporting ONR Grand Challenges in Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Electromagnetic Gun & and Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry and Naval Engineering.

FY 2006 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting ONR Grand Challenges in Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Electromagnetic Gun & and

BUDGET ACTIVITY: 01
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Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry and Naval Engineering.

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting ONR Grand Challenges in Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Electromagnetic Gun & and Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry and Naval Engineering.

	FY 2004	FY 2005	FY 2006	FY 2007
ELECTRONICS SENSOR SCIENCES	1,991	2,275	2,015	2,074

FY 2004 Accomplishments:

• Completed investigation of the feasibility of acoustic-optic reception of various in-water, composite signals for communications decoding.
• Completed investigation of 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.
• Completed investigation of 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:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY05 will focus on supporting ONR Grand Challenges in Electric Power Sources and Multifunctional Electronics for Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Persistent Surveillance, and the National Naval Responsibility Initiative in Undersea Weaponry.

FY 2006 Plans:

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting ONR Grand Challenges in Electric Power Sources and Multifunctional Electronics for Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Persistent Surveillance, and the National Naval Responsibility Initiative in Undersea Weaponry.

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting ONR Grand Challenges in Electric Power Sources and Multifunctional Electronics for Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Persistent Surveillance, and the National Naval Responsibility Initiative in Undersea Weaponry.

	FY 2004	FY 2005	FY 2006	FY 2007
INFORMATION SCIENCES	1,686	1,924	1,705	1,755

FY 2004 Accomplishments:

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

FY 2005 Plans:

Continue all efforts of FY04.

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY05 will focus on supporting ONR Grand Challenges in Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

FY 2006 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting ONR Grand Challenges in Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry.

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting ONR Grand Challenges in Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry.

	FY 2004	FY 2005	FY 2006	FY 2007
COMBAT CASUALTY CARE, INFECTIOUS DISEASES & MILITARY OPERATIONAL MEDICINE (USUHS)	1,685	1,924	1,705	1,755

FY 2004 Accomplishments:

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

BUDGET ACTIVITY: 01
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PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

FY 2005 Plans:

Continue all efforts of FY04 less those noted as completed above.

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY05 will focus on supporting ONR Grand Challenges in Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Sea Basing, and Navy-unique requirements in medicine and combat care.

FY 2006 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting ONR Grand Challenges in Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Sea Basing, and Navy-unique requirements in medicine and combat care.

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting ONR Grand Challenges in Intelligent Naval Sensors, Innovative Naval Prototypes initiatives in Sea Basing, and Navy-unique requirements in medicine and combat care.

	FY 2004	FY 2005	FY 2006	FY 2007
HUMAN PERFORMANCE SCIENCES	1,686	1,924	1,705	1,755

FY 2004 Accomplishments:

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

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PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

FY 2005 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY05 will focus on supporting the ONR Grand Challenge in Naval Battlespace Awareness, Innovative Naval Prototypes initiative in Sea Basing, and Naval interest in optimizing human performance in military environments.

FY 2006 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting the ONR Grand Challenge in Naval Battlespace Awareness, Innovative Naval Prototypes initiative in Sea Basing, and Naval interest in optimizing human performance in military environments.

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting the ONR Grand Challenge in Naval Battlespace Awareness, Innovative Naval Prototypes initiative in Sea Basing, and Naval interest in optimizing human performance in military environments.

	FY 2004	FY 2005	FY 2006	FY 2007
NAVAL PLATFORM DESIGN SCIENCES	1,073	1,224	1,085	1,116

FY 2004 Accomplishments:

• Completed the characterization of the salient near-wake turbulent physics of curved circular cylinders using large-eddy simulation methodology.
• Studied the environmental effects on the development of ship air-wakes.
• Completed the investigation of 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:

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

Continue all efforts of FY04 less those noted as completed above.

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY05 will focus on supporting ONR Grand Challenges in Electric Power Sources and Naval Materials by Design, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Sea Basing, and the National Naval Responsibility Initiative in Naval Engineering.

FY 2006 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting ONR Grand Challenges in Electric Power Sources and Naval Materials by Design, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Sea Basing, and the National Naval Responsibility Initiative in Naval Engineering.

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting ONR Grand Challenges in Electric Power Sources and Naval Materials by Design, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Sea Basing, and the National Naval Responsibility Initiative in Naval Engineering.

	FY 2004	FY 2005	FY 2006	FY 2007
ENERGY SCIENCES	1,073	1,224	1,085	1,116

FY 2004 Accomplishments:

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

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

FY 2005 Plans:

Continue all efforts of FY04 less those noted as completed above.

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY05 will focus on supporting ONR Grand Challenges in Electric Power Sources and Naval Materials by Design, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry and Naval Engineering.

FY 2006 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY06 will focus on supporting ONR Grand Challenges in Electric Power Sources and Naval Materials by Design, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry and Naval Engineering.

FY 2007 Plans:

ILIR projects are intended to be roughly three years long; therefore, typically 30% of the ILIR projects turn over each year. Projects selected for FY07 will focus on supporting ONR Grand Challenges in Electric Power Sources and Naval Materials by Design, Innovative Naval Prototypes initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility Initiatives in Undersea Weaponry and Naval Engineering.

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
NAVY S&T OUTREACH	0	1,882

The Naval Research Science and Technology for America's Readiness (N-Star) effort includes the development of an outreach activity at Navy R&D Centers collaborating with universities, community colleges, high schools, and middle schools to create a pipeline of students who are interested in pursuing careers in science and engineering fields.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601152N PROGRAM ELEMENT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)
PROJECT TITLE: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0601153N Defense Research Sciences

NON-NAVY RELATED RDT&E:
PE 0601101A In-House Laboratory Independent Research (Army)
PE 0601102F Defense Research Sciences (Air Force)

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
DEFENSE RESEARCH SCIENCES	364,243	380,441	356,885	366,680	380,244	388,940	397,009	405,922

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element (PE) 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) and Innovative Naval Prototypes (INPs). It responds to S&T directions of the DON Naval Power 21 (NP21) Transformational Roadmap, and Chief of Naval Operations (CNO) N70 Mission Capability Package (MCP) requirements for long term Navy and Marine Corps improvements. Defense Research Sciences is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command and the Marine Corps Combat Development Command, and enables technologies to significantly improve the Joint Chiefs of Staff (JCS) Future Joint Warfighting capabilities. It is managed by the Office of Naval Research (ONR) through Program Officers at ONR Headquarters, and the base program of the corporate Naval Research Laboratory (NRL).

The vision of the DON S&T strategy is "to inspire and guide innovation that will provide technology-based options for future Navy and Marine Corps capabilities", where "Innovation is a process that couples Discovery and Invention (D&I) with Exploitation and Delivery". DON basic research is the core of D&I. 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 fifteen research areas. These in turn support the major motivational research focus areas of the Navy and Marine Corps; maritime and space environments that impact operational capability, information science/knowledge management in network-centric operations, sensors and electronic systems for surveillance and tactical applications, energy/power/propulsion for performance gain and sustainment, advanced air/surface/undersea and multi-environment Naval platforms design/signature reduction, weapons systems for naval forces, and superior human performance/training/care of Sailors and Marines.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES

Key aspects of the program are the four ONR Grand Challenges which 'inspire and guide' the direction of research: Naval Battlespace Awareness, Electric Power Sources for the Navy and Marine Corps, Naval Materials by Design, and Multifunctional Electronics for Intelligent Naval Sensors. Key aspects also include the National Naval Responsibilities (NNRs), fields upon which a wide range of fundamental naval capabilities depend, and in which ONR is and likely will remain the principal US research sponsor. NNRs are ratified only after close scrutiny, and currently comprise Ocean Acoustics (started FY99), Underwater Weaponry (started FY02), and Naval Engineering (started in FY03). The basic research portfolio can be represented in three segments of emphasis identified as naval unique, participation, and harvest. Naval unique defines a category where the S&T is important to naval operations and largely undertaken only by the DON. It includes the NNR areas. Participation refers to S&T elements vital to naval operations, and naval investment can leverage funding sources other than DON such as airborne radars, communications and networks, materials sciences, and advanced energetic materials. Harvest defines cross cutting areas of science and engineering with potential to generate unanticipated naval capabilities or savings, and which DON should nurture such as nanoscience (potential new material properties) and the behavioral sciences.

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

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N
PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	375,363	375,812	390,131	397,748
Cong Rescissions/Adjustments/Undist. Reductions	0	-3,737	0	0
Congressional Action	0	8,400	0	0
Program Adjustments/realignments	0	-34	-33,560	-32173
Execution Adjustments	-3,837	0	0	0
Federal Technology Transfer	-31	0	0	0
Non-Pay Inflation Adjustments	-369	0	2	3
Rate Adjustments	0	0	312	1,102
SBIR Assessment	-6,883	0	0	0
FY 2006/2007 President's Budget Submission	364,243	380,441	356,885	366,680

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
DEFENSE RESEARCH SCIENCES	364,243	380,441	356,885	366,680	380,244	388,940	397,009	405,922

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) and Innovative Naval Prototypes (INPs). It responds to S&T directions of the Department of the Navy (DON) Naval Power 21 (NP21) Transformational Roadmap, and Chief of Naval Operations (CNO) N70 Mission Capability Package (MCP) requirements for long term Navy and Marine Corps improvements. Defense Research Sciences is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command and the Marine Corps Combat Development Command, and enables technologies to significantly improve the Joint Chiefs of Staff (JCS) Future Joint Warfighting Capabilities. It is managed by the Office of Naval Research (ONR) through Program Officers at ONR Headquarters, and the base program of the corporate Naval Research Laboratory (NRL).

The vision of the DON S&T strategy is "to inspire and guide innovation that will provide technology-based options for future Navy and Marine Corps capabilities", where "Innovation is a process that couples D&I with Exploitation and Delivery". DON basic research is the core of D&I. 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 fifteen research areas. These in turn support the major motivational research focus areas of the Navy and Marine Corps after Next: maritime and space environments that impact operational capability, information science/knowledge management in network-centric operations, sensors and electronic systems for surveillance and tactical applications, energy/power/propulsion for performance gain and sustainment, advanced air/surface/undersea and multi-environment Naval platforms design/signature reduction, weapons systems for naval forces, and superior human performance/training/care of Sailors and Marines.

BUDGET ACTIVITY: 01
PROGRAM ELEMENT: 0601153N PROGRAM ELEMENT TITLE: DEFENSE RESEARCH SCIENCES
PROJECT TITLE: DEFENSE RESEARCH SCIENCES

Key aspects of the program are the four ONR Grand Challenges which 'inspire and guide' the direction of research: Naval Battlespace Awareness, Electric Power Sources for the Navy and Marine Corps, Naval Materials by Design, and Multifunctional Electronics for Intelligent Naval Sensors. Key aspects also include the National Naval Responsibilities (NNRs), fields upon which a wide range of fundamental naval capabilities depend, and in which ONR is and likely will remain the principal US research sponsor. NNRs are ratified only after close scrutiny, and currently comprise Ocean Acoustics (started FY99), Underwater Weaponry (started FY02), and Naval Engineering (started in FY03). The basic research portfolio can be represented in three segments of emphasis identified as naval unique, participation, and harvest. Naval unique defines a category where the S&T is important to naval operations and largely undertaken only by the DON. It includes the NNR areas. Participation refers to S&T elements vital to naval operations, and naval investment can leverage funding sources other than DON such as airborne radars, communications and networks, materials sciences, and advanced energetic materials. Harvest defines cross cutting areas of science and engineering with potential to generate unanticipated naval capabilities or savings, and which DON should nurture such as nanoscience (potential new material properties) and the behavioral sciences.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
AIR, GROUND AND SEA VEHICLES	26,349	24,293	25,040	25,788

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; Unmanned Air Vehicle/Unmanned Combat Air Vehicle (UAV/UCAV); environmental quality; and logistics. Accomplishments and plans below are examples for each effort category.

Reflects realignment of R2 activities based on Chief of Naval Research (CNR) requirements.

FY 2004 Accomplishments:

Air Vehicles
• Continued exploration of communications and control concepts for autonomous collaboration between unmanned air vehicles.

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• Continued investigations into controlled initiation and recovery from aggressive non-linear aero-maneuvers conducted by unmanned air vehicles.

Ship Concepts and Hydrodynamics
• Continued the computational and experimental study of Coanda (fluid flow along surfaces) Flows.
• Continued detailed measurements of total wave field and resulting ship motions using new instrumentation.
• Continued development of Large-Eddy Simulation (LES) method for unsteady Propulsor tip-gap flow predictions.
• Continued development of reliable sea-keeping prediction methods for advanced surface ship hull forms in heavy seas.
• Continued wind tunnel experiments to characterize unsteady tip-gap flow in turbomachinery.
• Continued development of measurement technique for unsteady field point velocity using Particle Image Velocimetry (PIV).
• Continued vortex/vortex interaction experiments to understand the tip gap cavitation inception physics.
• Completed a ship breaking wave prediction method.
• Completed ranking of non-propulsor bubble sources around surface ships.
• Completed validation of new optimization procedure for prediction methods for ducted propellers and podded propellers.
• Completed seabase protection studies including concept design for a seabase, use of seaplanes including database of seaplanes with parametric studies for FY 2010+ assessment.
• Initiated nonlinear seakeeping code for structural loading of multi-hulls.
• Initiated modeling of two-way, unsteady, non-spherical bubble/vortical flow interaction and resulting acoustics.
• Initiated modeling and optimization techniques for Naval Design of Multi-Hulls, Optimal functional arrangements for both ship and submarine design, and optimization for semi-displacement craft.
• Initiated database of multi-hull and monohull small craft with tow tank test data for incorporation into new theories for scalable multi-hull design and high speed small vessels.
• Initiated hydrodynamic analysis of fast multi-hull ships.
• Initiated Vision based wave sensing for active ride control for small high speed craft (verified concept of predicting waves in the laboratory environment).
• Implemented web-based technical lessons/instruction/lab experiments for interested students/general public in Naval engineering principles.
• Instituted a nationwide distribution of small underwater remotely operated vehicles for hands-on instruction of Naval engineering principles at high schools.

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• Transitioned Unified Test Environment/Technical Identification, Evaluation System (UTE/TIES) design methodology to the Littoral Combat Ship to assess for monohull, trimaran, catamaran and surface effect ships (SES).

Ship Signatures, Structures, and Materials
• Continued development of computational mechanics to provide predictive capabilities of acoustics, linear and nonlinear dynamic response and failure mechanisms of structures.
• Continued study of ductile fracture in naval steels from materials issues through ship sections including ongoing modeling efforts.
• Developed reliability methodology for hull structures and hybrid joints.
• Developed physics based understanding of composite materials to characterize thermo-mechanical behavior, response to multi-axial loads and improve mechanical properties.
• Developed 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.
• Developed expanded scaleable simulation capabilities for virtual distributed control.
• Evaluated electromagnetic signature basic physics including scattering from multi-scaled dielectric materials and evaluation of visual rendering studies into high fidelity infrared modeling.

Environmental Sciences
• Continued examination of scientific methods for pollution prevention, waste reduction, and hazardous material reduction for Naval Operations.
• Determined 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.
• Developed high thermal conductivity polymer nanocomposites.
• Initiated assessment of the fate and effects of chemical and biological contaminants in marine/estuarine environments.

Ship and Air Platform Machinery and Systems
• Continued efforts to understand and control the generation and propagation of far-field jet noise.
• Quantified a three-dimensional (3D) turbo machinery flow using stereo PIV.
• Conducted studies of thermoelectric material requirements for shipboard cooling applications.
• Explored and evaluated control system algorithms and strategies in a virtual environment including affordability issues.
• Established limits for energy-time transients as a function of power system impedance parameters.

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- Constructed and conducted test run of a thermoacoustic piezoelectric generator.
- Completed work on quantification of active combustion control.
- Initiated efforts to design and test stability and control mechanisms for power distribution in nonlinear circuits.
- Initiated scientific approaches to alternate heat transfer and cooling methodologies.

FY 2005 Plans:

Air Vehicles
- Continue all efforts of FY 2004.

Ship Concepts and Hydrodynamics
- Continue all efforts of FY 2004 less those noted as completed above.
- Complete detailed measurements of total wave field and resulting ship motions using new instrumentation.
- Complete development of LES method for unsteady propulsor tip-gap flow predictions.
- Complete wind tunnel experiments to characterize unsteady tip-gap flow in turbomachinery.
- Complete development of unsteady field pressure measurement technique using PIV.
- Complete vortex/vortex interaction experiments to understand the tip gap cavitation inception physics.
- Complete Database efforts for multi-hull and monohull small craft with transfer of two dimensional (2D) body plans into 3D computer aided design (CAD) models.
- Complete efforts in development of Vision based wave sensing for active ride control for small high speed craft.
- Initiate investigation of the use of LES for acoustic prediction.
- Initiate comprehensive laser-doppler velocimetry (LDV) development for unsteady propulsor gap flow characterization.
- Initiate development of LES modeling of highly unsteady separated flow around ducted propulsor.
- Initiate Reynolds Averaged Navier-Stokes (RANS) predictions of surface ship motion for high speeds.
- Initiate quantification and modeling of bubble sources around surface ships for prediction methods.
- Initiate validating a breaking wave prediction method against experimental data.
- Initiate modeling and experiments for roughness-wall boundary layer noise.
- Initiate the Research Tools Development Consortia Program under the Program Decision Memorandum (PDM) for University Research - Engineering Design Consortia.
- Initiate and complete modeling of surface piercing propellers.
- Apply validated optimization procedure for ducted propellers and podded propellers to design analysis

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tools.
• Expand nationwide distribution of small underwater remotely operated vehicles for hands-on instruction of Naval Engineering principles at high schools.
• Transition UTE/TIES design methodology for application on Submarine Synthesis Tool.
• Implement a nationwide program to educate high school guidance counselors on Naval engineering career opportunities.

Ship Signatures, Structures, and Materials
• Continue all efforts of FY 2004 less those noted as completed above.
• Evaluate electromagnetic signature basic physics to further understand low observable and IR technology performance against evolving threats.
• Initiate further examination of computational mechanics in order to address prediction of acoustic signatures in complex structures, modeling of structural failures and optimization, sensitivity analysis, and error control.

Environmental Sciences
• Continue all efforts of FY 2004 less those noted as completed above.
• Determine most promising foul-release approaches based on silicones to meet Navy durability requirements for further development and testing.
• 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.
• Conduct membrane research to correlate filtration efficiency with nano-fibrous membrane porosity, thickness, fiber diameter and chemical composition.
• Conduct efforts to improve membrane materials for high-flux and low-fouling efficiency with proper composite design, chemical modifications and materials selection.
• Conduct work on characterization of solute-membrane interactions using strongly fouling solutes (silica, proteins, CaCO3, oil, etc.) using long-term permeation and Fourier Transform Infrared Spectroscopy - attenuated total reflectance (FTIR-ATR) data.
• Conduct studies of mixed polyethyleneglycole (PEG), quantitative polyvinylpyrrolidone (PVP) surfaces & fouling release behavior.
• Conduct initial analysis of feasibility of medium dense plasma for liquid purification.
• Conduct efforts to measure the mechanisms for fouling release and to compare the skin friction properties of conventional and fouling release ship hull coatings.
• Explore low-energy laser induced incandescence schemes to avoid soot vaporization and extend light

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scattering measurements to soot burn-out regime.
• Develop bryozoans as new model organism used in assessment of coatings.
• Use hydrodynamic drag measurements to quantify force vs. speed on pseudo barnacles attachment to various surfaces.
• Investigate molecular structures of fluorinated polymers in air and in water to reveal their molecular surface structure.
• Study interactions between newly developed biofouling control/release polymers and mussel adhesive.
• Initiate investigation of effect of fluorinated block co-polymer uniformity on fouling release.
• Initiate efforts in rotating drum testing of anti-fouling coatings.
• Initiate new anti-fouling coating testing capabilities in international locations.
• Initiate effort on pier side robotic hull fouling control/surveillance technologies.
• Initiate emphasis on ultrafiltration membranes for bioreactors.

Ship and Air Platform Machinery and Systems
• Continue all efforts of FY 2004 less those noted as completed above.
• Examine turbomachinery flow using holographic PIV.
• Validate LES predictions of turbomachinery flow against experimental data.
• Integrate distributed heterogeneous control simulation capability into the overall control system simulation infrastructure.
• Test and evaluate control system algorithms and strategies in a virtual environment including affordability issues.
• Further evaluate stability and control of model electrical power systems.
• Perform half and full-scale engine testing of most promising on-board noise reduction technologies (e.g. air/water injection).
• Initiate development of advanced magnetocaloric materials for magnetic refrigeration.
• Initiate effort on pier side robotic hull fouling control/surveillance technologies.
• Initiate seabasing effort for an Advanced Logistics Delivery System including new technologies for gliders and ship launching methods.

FY 2006 Plans:

Air Vehicles
• Continue all efforts of FY 2005.

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Ship Concepts and Hydrodynamics
- Continue all efforts of FY 2005 less those noted as completed above.
- Complete the computational and experimental study of Coanda flows.
- Complete comprehensive LDV development for unsteady propulsor gap flow characterization.
- Complete modeling of two-way, unsteady, non-spherical bubble/vertical flow interaction and resulting acoustics.
- Complete validating a breaking wave prediction method against experimental data.
- Complete efforts in nonlinear seakeeping code for structural loading of multi-hulls.
- Complete efforts in modeling and optimization techniques for Naval Design of Multi-Hulls, Optimal functional arrangements for both ship and submarine design.
- Complete efforts in modeling of surface piercing propellers.
- Initiate the investigation of the effect of roughness on turbulent boundary layers.
- Initiate holographic PIV system development for unsteady 3D turbo machinery flow.
- Initiate modeling of two-phase flow using LES method.
- Initiate and complete validation of panel-code prediction of nonlinear waves and capsize using model scale data.
- Initiate and complete validation of prediction methods for bubble sources around surface ships.
- Initiate and complete validation of RANS predictions of surface ship motion in pitch and heave.
- Initiate further examination of computational mechanics in order to address prediction of acoustic signatures in complex structures, modeling of structural failures and optimization, sensitivity analysis and error control.
- Initiate the Research Tools Development Consortia Program for University Research - Engineering Design Consortia.

Ship Signatures, Structures, and Materials
- Continue all efforts of FY 2005 less those noted as completed above.
- Complete efforts in modeling of ductile fracture in naval steels.

Environmental Sciences
- Continue all efforts of FY 2005 less those noted as completed above.

Ship and Air Platform Machinery and Systems
- Continue all efforts of FY 2005 less those noted as completed above.
- Integrate distributed heterogeneous control simulation capability into the overall control system

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simulation infrastructure.
• Test and evaluate control system algorithms and strategies in a virtual environment including affordability issues.
• Complete efforts in seabasing for an Advanced Logistics Delivery System.

FY 2007 Plans:

Air Vehicles
• Continue all efforts of FY 2006.

Ship Concepts and Hydrodynamics
• Continue all efforts of FY 2006 less those noted as completed above.
• Complete modeling and experiments for roughness-wall boundary layer noise.
• Complete RANS predictions of surface ship motion for high speeds.
• Complete LES modeling of highly unsteady separated flow around ducted propulsor against water tunnel measurements.
• Initiate and complete validation of six degrees of freedom (6DOF) RANS for surface ship motions (without capsize).
• Initiate and complete validation of prediction of ship wave breaking and bubbly flow at full scale.
• Determine most promising foul-release approaches based on silicones to meet Navy durability requirements for further development and testing.
• Perform half and full-scale engine testing of most promising on-board noise reduction technologies (e.g. air/water injection).

Ship Signatures, Structures, and Materials
• Continue all efforts of FY 2006 less those noted as completed above.

Environmental Sciences
• Continue all efforts of FY 2006.
• Complete efforts to increase strength in silicone based polymers for antifouling/friction reduction (AF/FR) coatings.

Ship and Air Platform Machinery and Systems
• Continue all efforts of FY 2006 less those noted as completed above.

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- Further examine turbomachinery flow.
- 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.

	FY 2004	FY 2005	FY 2006	FY 2007
ATMOSPHERE AND SPACE SCIENCES	38,514	40,848	23,500	18,985

Efforts include: Marine Meteorology and Prediction; High Frequency Active Auroral Research Program (HAARP) and Space Sciences. Accomplishments and plans below are examples for each effort category.

Reflects realignment of activities based on CNR requirements.

FY 2004 Accomplishments:

Marine Meteorology and Prediction
- Assessed validation of environmental data and models used by S&T community to ensure reliability and realistic depiction of actual ocean and atmospheric conditions.

High Frequency Active Auroral Research Program (HAARP)
- Continued project to complete HAARP. All antennas were installed by the end of 2004.

Space Sciences
- Continued calibration/validation of WINDSAT polarimetric passive microwave data. (NRL)
- Continued the development of 3D magneto-hydrodynamic code for simulations of solar filament eruptions leading to flare and coronal mass ejection (CME) activity. (NRL)
- Substantial progress in the development of 3D magneto-hydrodynamic code for simulations of solar filament eruptions leading to flare and coronal mass ejection (CME) activity. (NRL)
- Completed extensive studies of the major Oct.-Nov. 2003 solar activity events and associated effects on the near-Earth space environment. (NRL)
- Assessed improvements to specification and prediction of the space environment to improve space system performance and their on-call availability.
- Developed and initiated validation of advanced techniques and algorithms for remote sensing of ocean and

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atmospheric properties including winds, waves, currents, and surface topography.

FY 2005 Plans:

Marine Meteorology and Prediction
• Continue all efforts of FY 2004.
• Investigate and better understand the bulk exchanges, aerosol-cloud interaction, and physical processes that take place at the atmospheric boundary layer interface. (Includes NRL investment/performance in this effort.)

High Frequency Active Auroral Research Program (HAARP)
• Complete improvements in the performance of the HAARP with the installation of transmitters.

Space Sciences
• Continue all efforts of FY 2004 less those noted as completed above.
• Investigate the near-earth environmental effects on electromagnetic propagation. (NRL)
• Expand modeling of the near-Earth space environment with the development a self-consistent coupled model of the solar wind/magnetosphere/ionosphere system. (NRL)
• Evaluate/develop techniques for remediation of nuclear-enhanced radiation belts using amplification induced whistler waves or turbulent plasma created by ionizable chemical release. (NRL)
• Improve understanding of tropospheric and stratospheric bulk exchanges through observations and modeling. (NRL)

FY 2006 Plans:

Marine Meteorology and Prediction
• Continue all efforts of FY 2005.
• Complete validation of environmental data and models used by S&T community to ensure reliability and realistic depiction of actual ocean and atmospheric conditions.
• Initiate the design next-generation ocean-atmosphere coupled models.

Space Sciences
• Continue all efforts of FY 2005.
• Assess advanced improvements to specification and prediction of the space environment to improve space

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system performance and their on-call availability. (Includes NRL investment/performance in this effort.)
• Assess advanced techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography.

FY 2007 Plans:

Marine Meteorology and Prediction
• Continue all efforts of FY 2006 less those noted as completed above.
• Continue programs to develop the next-generation ocean-atmosphere coupled models.
• Assess status of aerosol observation, prediction, and understanding for use in slant-range visibility models.

Space Sciences
• Continue all efforts of FY 2006.
• Initiate program to develop advanced improvements to specification and prediction of the space environment to improve space system performance and their on-call availability.
• Initiate monitoring of other-agency efforts for Naval Harvest of advanced techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography.
• Demonstrate skill in modeling and predicting near-earth environmental effects on electromagnetic propagation. (NRL)

	FY 2004	FY 2005	FY 2006	FY 2007
HUMAN SYSTEMS	9,525	8,028	8,360	8,719

Efforts include: human factors and organizational design; manpower, personnel, and training; integrated avionics, displays, and advanced cockpit; and pattern recognition. Accomplishments and plans below are examples for each effort category.

Reflects realignment of activities based on CNR requirements.

FY 2004 Accomplishments:

Cognitive, Neural and Social Science
• Continued study of social networks for counterterrorism.

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- Continued expansions to cognitive models to include spatial reasoning.
- Continued studies of attention management in multi-tasking.
- Continued study of retinal information processing and modeling.
- Continued research on human cognition and performance to create more realistic simulations for training.
- Initiated program to combine cognitive architectures with computational neuroscience to better predict human performance.
- Initiated development of novel multidisciplinary approaches to human-activity inference from video imagery to enable force protection and counterterrorism.
- Initiated program on implantable electronics for performance enhancement.
- Initiated studies of hierarchical, cellular, and hybrid organization structures for command and control.
- Initiated schema theory applications to multi-echelon command decision making.

FY 2005 Plans:

Cognitive, Neural and Social Science
- Continue all efforts of FY 2004.
- Complete study of retinal information processing and modeling environments.
- Initiate study of neuro-control of Unmanned Underwater Vehicles (UUVs) and active vision and cognitive navigation skills in mobile robots.

FY 2006 Plans:

Cognitive, Neural and Social Science
- Continue all efforts of FY 2005 except those noted as completed above.
- Complete studies of attention management in multi-tasking.

FY 2007 Plans:

Cognitive, Neural and Social Science
- Continue all efforts of FY 2006 except those noted as completed above.
- Complete development of novel multidisciplinary approaches to human-activity inference from video imagery to enable force protection and counterterrorism.
- Complete expansions to cognitive models to include spatial reasoning.

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	FY 2004	FY 2005	FY 2006	FY 2007
INFORMATION SCIENCES	21,399	23,396	23,470	23,300

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

Reflects realignment of activities based on CNR requirements.

FY 2004 Accomplishments:

• Continued development of mathematical optimization framework and heuristic algorithms that serve as theoretical and computational basis for network design, optimal sensor allocation, and logistics.
• Continued refinement of techniques for ensuring privacy of information transferred across public networks.
• Continued development of improved tactical and battlespace decision aids through creation of synthetic natural environments.
• Continued to refine techniques for extracting maximum knowledge from multi-modal imagery, text, and electromagnetic signal data.
• Continued to investigate methods to deal with light dispersion on image formation underwater to enable precise navigation, station keeping, and mapping capabilities for unmanned underwater vehicles.
• Continued 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.
• Continued developing framework for dealing with effect of variable latencies in communication within teams of humans and autonomous systems.
• Continued 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.
• Continued efforts on quantum computing and cryptography.

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- Continued efforts on general automated theorem prover technologies and biometric technologies for authentication.
- Continued efforts in multi-modal dialog.
- Continued efforts in physics-based modeling of natural phenomena.
- Continued 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.
- Continued development of technology for the automated construction of high assurance software. (NRL)
- Completed development of technology for multimodal interaction with autonomous systems. (NRL)
- Completed development of new technology for hiding and detecting information hidden in pictures. (NRL)
- Initiated efforts on modeling chaotic phenomena in network operations.
- Initiated efforts for integrating domain knowledge into learning methods.
- Initiated efforts for semantic-based information gathering.
- Initiated efforts in extended augmented/virtual reality with haptics, sound, and olfactory components.
- Refined theory and algorithms for autonomous systems to recognize a particular scene from different perspectives.
- Refined turbo-codes and iterative processing techniques to enable high data rates for wireless communication applications.
- Developed a framework for collaborative mission planning tools to facilitate knowledge sharing and management, regulation of information flow, and work-process monitoring.
- Developed adaptive routing protocols to select the links for routing information packets that maximize communication network throughput with minimum energy consumption.
- Investigated Extremely Low Frequency (ELF) modulation and efficiency improvements and magnetospheric propagation.
- Initiated development of technology for maximizing information delivery in tactical networks via encoding information under speech. (NRL)
- Initiated development of technology for increasing efficiency of tactical wireless networks based on fundamental invariants for random-access protocols. (NRL)
- Initiated development of technology for improving behavior of coordinated teams of autonomous systems. (NRL)

FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed above.

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• Develop computational framework for integrating information of disparate sources - Program Decision Memorandum (PDM) for University Research - Surveillance & Knowledge Systems.
• Develop a systematic approach that will serve as a theoretical and computation basis for automated image understanding and automatic object recognition.
• Complete refinement of techniques for ensuring privacy of information transferred across public networks.
• Complete collaborative mission planning tools to facilitate knowledge sharing and management, regulation of information flow, and work-process monitoring.
• Complete development of technology for the automated construction of high assurance software (NRL)
• Initiate the development of technology to improve tactical wireless ad hoc networks via development of cross-layer design approaches (NRL)

FY 2006 Plans:

• Continue all efforts of FY 2005 less those noted as completed above.
• Continue efforts in extended augmented/virtual reality with haptics, sound, and olfactory components.
• Complete development of techniques for maximizing information delivery in tactical networks via encoding information under speech. (NRL)
• Complete development of technology for increasing efficiency of tactical wireless networks based on fundamental invariants for random-access protocols. (NRL)
• Initiate development of technology to improve secure information sharing. (NRL)

FY 2007 Plans:

• Continue all efforts of FY 2006 less those noted as completed above.
• Complete efforts in extended augmented/virtual reality with haptics, sound, and olfactory components.
• Complete the development of technology to improve tactical wireless ad hoc networks via development of cross-layer design approaches. (NRL)
• Initiate development of technology to re-engineer legacy code. (NRL)

	FY 2004	FY 2005	FY 2006	FY 2007
MATERIALS/PROCESSES	69,162	73,256	74,208	81,885

Efforts include: Structural materials; functional materials; and maintenance reduction. Accomplishments and plans below are examples for each effort category.

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Reflects realignment of activities based on CNR requirement.

FY 2004 Accomplishments:

Structural Materials
- Continued to develop understanding and constitutive models of dynamic behavior of naval steels.
- Developed and validated physics-based models of thermal and materials flow during friction stir welding of steels, including the development of residual stresses that will lead to distortion.
- Developed first-principles based methodologies for predicting the thermodynamics and kinetics controlling microstructural evolution for the design of advanced Naval steels.
- Designed, synthesized, and developed welding consumables and process methodologies for joining superaustenitic stainless steels.
- Developed theoretical basis for composite materials behavior based on x-ray computed micro-tomography.
- Advanced the understanding of deformation mechanisms in nanometer scale aluminum and steels to provide new high strength-high toughness alloys for naval platforms.
- Developed models and simulations to understand and predict high deformation rate blast behavior for engineered topological structures.
- Developed understanding linking complex reaction paths and atomic diffusion in the formation of environmental and diffusion barrier coatings for high temperature thermal and environmental barrier coatings.
- Developed the dynamic response (constitutive behavior, failure) for marine composites and sandwich structures.
- Developed nanocomposites for enhancing mechanical properties of marine composites.
- Optimized the role of oxygen in titanium alloys. (NRL)
- Demonstrated chemical synthesis of carbon nanotubes in large quantities and high yield in bulk solid. (NRL)
- Developed laser-based machining techniques and data acquisition equipment have been used to create arrays of defects, deposit local DC potential drop sensors and measure five simultaneous combinatorial experiments in a single fatigue specimen. (NRL)
- Determined structure of analog of elastin (component of the walls of arteries) and a probable mechanism for elasticity on a molecular level. (NRL)
- Demonstrated successful brazing and sintering of high-purity ceramics. (NRL)
- Completed effort in Magnetic Phenomena in Reduced Dimensions (NRL)

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Functional Materials
• Developed first principle methods to calculate second and third rank tensor properties of sonar materials such as lead zirconate titanate and lead magnesium niobate.
• Developed integrated bio-magneto-electronic structures and devices for experimental evaluation.
• Developed a computational model of the interaction of fine water mist with an opposed-jet flame for flame suppression. (NRL)
• Identified, quantified, and controlled the atomic scale properties that limit or enhance the performance of magnetic semiconductor materials.
• Designed and synthesized a new porous carbon platform for fuel cell catalysis where 86% of the surface Pt atoms are electrocatalytic. (NRL)
• Invented/Patented a New Class of Nanoscale Hierarchical Optical Polymers. (NRL)
• Demonstrated unification of basic concepts from propulsion, combustion, and astrophysics led to concepts for two new types of micropropulsion devices based on controlled interactions of flames and boundary layers. (NRL)
• Demonstrated that Dip Pen Nanolithography (DPN) can be used to produce versatile chemical templates on silicon oxide surfaces. (NRL)
• Demonstrated high definition masks for measurements in left handed materials. (LHM) (NRL)
• Demonstrated use of virus as a scaffold for signal amplification. (NRL)
• Demonstrated an innovative detonation initiation technique and PDE operation with liquid JP10. (NRL)
• Determined changes in optical properties of organic matter during estuarine transport. (NRL)
• Evaluation of tunable pulsed laser systems for growth of organic thin films by Resonant Infra Red Pulsed Laser Deposition. (RIR-PLD) (NRL)
• Characterized (mechanistically and quantitatively) the rate of iron bioreduction in ferruginous smectite within the contexts of marine suspended particle dynamics and sediment geotechnical properties. (NRL)
• Analyzed nanostructures formed in silicon and thin film wafers by novel, laser-assisted direct imprinting (LADI) technique. (NRL)

Maintenance Reduction
• Identified 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.
• Developed the science of sliding contact and lubrication using physical and chemical first principles.
• Explored transgranular crack tip damage mechanism in ultra high strength steels.
• Investigated the use of photorefractive crystals for the demodulation of a distributed fiber optic Bragg

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gratings structural health monitoring system.
• Completed effort in Magnetic Phenomena in Reduced Dimensions. (NRL)
• Initiated investigation of continuous growth of single and multiwall nanotubes for next generation polymer matrix composite materials.

FY 2005 Plans:

Structural Materials
• Continue all efforts of FY 2004 less those noted as completed above.
• Explore superplasticity in advanced high strain nanometer scale ceramic composites to provide the basis for the development of such materials in naval applications.
• Develop materials and fabrication science for fugitive phase processes for engineered topological structures for ship blast protection.
• Begin to explore the design of advanced steels for weldability based on previous first-principles efforts.
• Initiate investigation of the role of hydrogen and nitrogen on mechanical properties of titanium alloys. (NRL)
• Initiate investigation of joining of dissimilar ceramics and sintering of light metal composites. (NRL)

Functional Materials
• Continue all efforts of FY 2004 less those noted as completed above.
• 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 and develop materials for high energy density passive power electronics.
• Optimize nanoimprinting process. Eliminate grain boundaries, triple points and diffusion of substrate elements in nanoimprinted metal thin films. (NRL)
• Initiate development of Materials/Fabrication Science to Exploit the New Structured Optical Polymers. (NRL)

Maintenance Reduction
• Continue all efforts of FY 2004 less those noted as completed above.
• Begin first lubrication-by-design experiments.
• Identify hydrogen embrittlement resistant high strength alloys based on nickel-cobalt-chrome-molybdenum material systems.
• Explore advanced coatings with multifunctional corrosion/fouling properties.

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- Explore advanced theoretical concepts for corrosion control.
- Explore multienergy processes for zero maintenance coatings.
- Complete effort in Fault Identification and Failure Prediction Technologies. (NRL)

FY 2006 Plans:

Structural Materials
- Continue all efforts of FY 2005 less those noted as completed above.
- Complete design, synthesis and development of welding consumables and process methodologies for joining superaustenitic stainless steels.
- Initiate exploration into the processing and microstructures of novel titanium alloys that may be enabled by new co-reduction of mixed metallic oxide processes.
- Develop progressive damage models for blast effects on composite marine structures.
- Develop concepts for enhancing resistance to dynamic loading on composite marine structures.
- Explore microstructural evolution during solid-state joining and localized processing of weldments in titanium alloys for improved toughness and fatigue resistance.
- Explore advanced techniques for Blast Mitigation. (NRL)
- Evaluate Polycrystalline Ceramic Laser Materials. (NRL)
- Investigate the role of rare earth additions to titanium alloys using newly developed processing technique. (NRL)
- Fabricate extended 2-D LHM structures. (NRL)

Functional Materials
- Continue all efforts of FY 2005 less those noted as completed above.
- Explore and predict new sonar materials based on first principle methods.
- Explore new transduction mechanisms.
- Complete projects in 1) Nanofilaments: Interfacial Interactions, Manipulation and Assembly and 2) Half-Metallic Electronic Materials. (NRL)
- Complete protection of carbon nanotubes against oxidation at elevated temperatures and transition into other spin-off programs. (NRL)
- Initiate examination of the effects of acoustic perturbations and interactions in reacting flows and determine how they can be used. (NRL)
- Initiate investigation of Radically New Hierarchical Polymer GRIN Lenses that Mimic the Focusing of an Eye. (NRL)

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- Initiate single molecule binding detection using optical trap. (NRL)
- Initiate effort to fabricate extended 2-D LHM structures. (NRL)

Maintenance Reduction
- Continue all efforts of FY 2005 less those noted as completed above.
- Test a statistically relevant number of combinatorial specimens to rank defects, microstructure and their interactions for fatigue crack initiation and growth. (NRL)

FY 2007 Plans:

Structural Materials
- Continue all efforts of FY 2006 less those noted as completed above.
- Complete development and validation of physics-based models of thermal and materials flow during friction stir welding of steels, including the development of residual stresses that lead to distortion.
- Complete the development of understanding of deformation mechanisms in nanometer scale aluminum and steels for new high strength-high toughness alloys for naval platforms.
- Complete efforts to understand links between complex reaction paths and atomic diffusion in the formation of environmental and diffusion barrier coatings for high temperature thermal and environmental barrier coatings.
- Complete analysis of dynamic response (constitutive behavior, failure) for marine composites and sandwich structures.
- Investigate rapid annealing of surface layers and their effects. (NRL)

Functional Materials
- Continue all efforts of FY 2006 less those noted as completed above.
- Synthesize and measure the properties of new sonar materials predicted by first principle methods.
- Develop and transition advanced bio-magneto-electronic materials and devices.
- Complete development of first principle methods to calculate second and third rank tensor properties of sonar materials such as lead zirconate titanate and lead magnesium niobate.

Maintenance Reduction
- Continue all efforts of FY 2006 less those noted as completed above.
- Complete efforts to identify stress corrosion control methods for friction stir welded high-strength aluminum alloys using advanced thermal treatments, chemical modifications, and surface mechanical processes to

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tailor compressive stresses.
• Complete exploration of transgranular crack tip damage mechanism in ultra high strength steels.

	FY 2004	FY 2005	FY 2006	FY 2007
MEDICAL/BIOLOGY	15,545	14,665	15,072	15,563

Efforts include: 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. Accomplishments and plans below are examples for each effort category. Reflects realignment of activities based on CNR requirements.

FY 2004 Accomplishments:

Medical Sciences
• Continued research to understand individual variability in stress response.
• Continued non-lethal weapons bioeffects research.
• Continued work on stress physiology, hyperbaric physiology, and biological effects of naval operational exposures (e.g., directed energy).
• Continued work on genomics/genetic immunization for infectious organisms of military relevance, stem cells, and signal transduction.
• Completed functional genomic and proteomic analysis of early stages of anthrax infection.

Biological Sciences
• Continued studies of effects of noise on marine mammal hearing and behavior.
• Continued studies on fate and effects of energetic and other organic compounds in marine environments.
• Continued research on virus-based nanoarchitectures.
• Continued work on microbial synthesis of energetic materials.
• Continued development of novel genetic sequencing tools for marine algae and seaweeds.
• Continued research on biofouling.
• Continued studies of marine mammal biomimetic/biorobotic systems.
• Completed marine mammal immunobiology studies.
• Initiated efforts to develop next-generation, supramolecular antibiotics.
• Initiated development of genetically encoded markers of signal transduction.
• Initiated work to recharge naval ocean instruments with sediment biofuel cells.

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FY 2005 Plans:

Medical Sciences
- Continue all efforts of FY 2004 less those noted as completed above.

Biological Sciences
- Continue all efforts of FY 2004 less those noted as completed above.
- Complete development of novel genetic sequencing tools for marine algae and seaweeds.
- Initiate development of ultra-high performance cell sorters.
- Initiate research to understand physiological effects of naval sonar exposures on marine mammals.

FY 2006 Plans:

Medical Sciences
- Continue all efforts of FY 2005.
- Complete studies on fate and effects of energetic and other organic compounds in marine environments.

Biological Sciences
- Continue all efforts of FY 2005 less those noted as completed above.
- Complete studies of marine mammal biomimetic/biorobotic systems.

FY 2007 Plans:

Medical Sciences
- Continue efforts of FY 2006 less those noted as completed above.

Biological Sciences
- Continue efforts of FY 2006 less those noted as completed above.

	FY 2004	FY 2005	FY 2006	FY 2007
OCEAN SCIENCES	79,356	87,612	87,881	90,814

Efforts include: Littoral Geosciences, Optics, and Biology; Marine Mammals; Physical Oceanography and

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Prediction; Ocean Acoustics; and University National Oceanographic Laboratory System (UNOLS). Accomplishments and plans below are examples for each effort category.

Reflects realignment of activities based on CNR requirements.

FY 2004 Accomplishments:

Littoral Geosciences, Optics, and Biology
• Developed programs to validate techniques for utilizing high resolution, motion imagery methods to predict beach evolution.
• Implemented investigation of fate and effects of unexploded ordnance in the marine environment to reduce the threat to civilian population and military explosive ordnance disposal personnel.
• Initiated 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.
• Initiated effort to improve accuracy of the "5-cm geoid" and precise geodesy. (NRL)

Marine Mammals
• Initiated 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.

Physical Oceanography and Prediction
• Continued to develop state of the art numerical model assimilation and initialization techniques, improved physical parameterizations, air-sea interactions, and fidelity for atmospheric and ocean prediction systems. (Includes NRL investment/performance in this effort.)
• Conducted opportunistic validation of global on-scene, accurate, theater scale, high resolution environmental characterizations and forecasts to improve all weather operations and defense capabilities of acoustic, electro-optical, and infrared (EO/IR) sensors, and the performance of Naval weapons in the atmosphere and under the sea.

Ocean Acoustics
• Continued development of a coupled hydrodynamic-acoustic model for sound generation from breaking waves. (Includes NRL investment/performance in this effort.)
• Continued development of numerical methods to predict the effects of the sub-surface bubble layer on

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underwater acoustics propagation and scattering. (Includes NRL investment/performance in this effort.)
• Continued to research effect of solitons and internal wave bores on acoustic propagation and buoyancy. (Includes NRL investment/performance in this effort.)
• Developed advanced methods for combining "through the sensor" data with other views of the battlespace environment to improve real-time environmental predictions. (Includes NRL investment/performance in this effort.)

FY 2005 Plans:

Littoral Geosciences, Optics, and Biology
• Continue all efforts of FY 2004.
• Develop techniques to exploit hyperspectral data from a geostationary platform to better understand coastal ocean dynamics. (Includes NRL investment/performance in this effort.)
• Better understand extent and intensity of seafloor gas hydrate accumulations and coastal bio-optical response to air-ocean forcing. (Includes NRL investment/performance in this effort.)

Marine Mammals
• Continue all efforts of FY 2004.

Physical Oceanography and Prediction
• Continue all efforts of FY 2004.
• Initiate an assessment of the role of emerging sub-mesoscale parameterization techniques for improving next generation high resolution/high accuracy environmental models.
• Initiate design evaluation for a persistent mobile sampling network based on autonomous undersea vehicle platform and sensor technologies.

Ocean Acoustics
• Continue all efforts of FY 2004.
• Complete development of the coupled hydrodynamic-acoustic model for sound generation from breaking waves. (Includes NRL investment/performance in this effort.)
• Initiate development of an improved Nonlinear Progressive Wave Equation model for shallow water applications. (NRL)
• Initiate comparison of numerical methods that predict effects of sub-surface bubble layers on acoustics to laboratory measurements. (NRL)

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FY 2006 Plans:

Littoral Geosciences, Optics, and Biology
• Continue all efforts of FY 2005.
• Initiate programs to estimate optical properties of coastal ocean water from above-surface sensing, using in-situ data for validation.

Marine Mammals
• Continue all efforts of FY 2005.
• Initiate new efforts on tracking of marine mammals using data fusion based on tags and remote sensing.

Physical Oceanography and Prediction
• Continue all efforts of FY 2005.
• Initiate field efforts for a persistent mobile sampling network based on autonomous undersea vehicle platform and sensor technologies.

Ocean Acoustics
• Continue all efforts of FY 2005 less those noted as completed above.
• Complete development and comparisons with data of numerical methods to predict effects of sub-surface bubble layers on acoustic propagation and scattering. (NRL)
• Complete incorporation of stochastic parameters into underwater acoustic propagation models. (Includes NRL investment/performance in this effort.)
• Complete development and comparisons with data of numerical methods to predict effects of sub-surface bubble layers on acoustic propagation and scattering. (NRL)
• Initiate studies of adaptive beam-forming using mobile, autonomous sensors.
• Initiate numerical simulations to investigate the analogs of condensed matter physics phenomena in ocean acoustics. (NRL)

Ocean Class Research Vessel- $4,000
• Assess optimum hull forms for Ocean Class platform/craft oceanographic research mission.
• Assess novel mission equipment options to ensure technology infusion.
• Initiate preliminary and detailed design studies of the selected hull form.
• Initiate a review and prioritize science mission requirements in conjunction with oceanographic research

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community and University National Oceanographic Laboratory System (UNOLS) members.
• Initiate program management.

FY 2007 Plans:

Littoral Geosciences, Optics, and Biology
• Continue all efforts of FY 2006.
• Begin to incorporate improved understanding of tropospheric and stratospheric bulk exchanges, air-sea interface, boundary layer interface, coastal ocean dynamics, gas hydrate accumulation, and biological responses into atmospheric and ocean prediction models and tactical aids. (Includes NRL investment/performance in this effort.)

Marine Mammals
• Continue all efforts of FY 2006.
• Complete study of an integrative ecosystem study to provide environmental predictors of whale presence or absence to reduce impacts of naval systems to marine mammals.

Physical Oceanography and Prediction
• Continue all efforts of FY 2006.

Ocean Acoustics
• Continue all efforts of FY 2006 less those noted as completed above.
• Assess “time-reversal” propagation techniques for mitigation of environmental variability.
• Complete development of the Nonlinear Progressive Wave Equation model. (NRL)
• Complete investigations of analogs of condensed matter physics phenomena in ocean acoustics. (NRL)
• Initiate field work on adaptive beamforming using mobile, autonomous sensors.

Ocean Class Research Vessel- $25,000
• Continue all efforts of FY 2006.
• Initiate construction of vessel

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SCIENCE AND ENGINEERING EDUCATION, CAREER DEVELOPMENT AND OUTREACH	35,698	42,749	40,555	42,887

Science and Engineering Education and Career Development activities include DON participation in science fairs, summer research interns/fellows at Navy laboratories, graduate fellowships for individuals expected to become members of the engineering faculty at Historically Black Colleges and Universities and Minority Institutions (HBCU/MIs), and curricular enrichment programs. Outreach includes the encouragement, promotion, planning, coordination and administration of Naval Science and Technology. In previous submissions, this activity has not been identified separately but rather integrated into the other PE activities as it applied.

Reflects realignment of activities based on CNR requirements.

FY 2004 Accomplishments:

- Continued awarding prizes at 400 regional science fairs and three national competitions.
- Continued supporting 200 students as summer research interns at Navy laboratories.
- Continued providing graduate fellowship support to eight HBCU engineering faculty candidates.
- Assisted JASON project to provide video ocean science pre-college course enrichment materials.
- Supported 60 HBCU/MI faculty members as summer research fellows at Navy laboratories.
- Continued the encouragement, promotion, planning, coordination and administration of Naval Science and Technology.

FY 2005 Plans:

- Continue all efforts of FY 2004 less HBCU/MI faculty support and JASON assistance which were one-year efforts.

FY 2006 Plans:

- Continue all efforts of FY 2005.

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FY 2007 Plans:

• Continue all efforts of FY 2006.

	FY 2004	FY 2005	FY 2006	FY 2007
SENSOR, ELECTRONICS AND ELECTRONIC WARFARE (EW)	50,931	48,810	50,041	48,209

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. Accomplishments and plans below are examples for each effort category.

Reflects realignment of activities based on CNR requirements.

FY 2004 Accomplishments:

• Continued effort to incorporate non-equilibrium considerations into modeling of realistic superconducting tunnel junctions when barrier is near the metal/insulator transition.
• Continued to explore optical super resolution techniques with atmospheric turbulence reduction techniques.
• Continued investigation of temporal-spatial sampling circuits and architectures for digital-to-analog conversion.
• Continued to improve room temperature 4.5-4.8 micron quantum cascade laser by reducing emission wavelength and further increasing power to meet laser source requirements for infrared countermeasures against heat-seeking missiles.
• Continued advanced height finding and detection algorithms for high frequency radar.
• Continued comprehensive study of compressive and tensile strain patterned semiconductor quantum wells using micromachining. (NRL)
• Continued proof of principle demonstration of microcavity chemical sensor. (NRL)
• Continued invention of a new technique for micromachining quantum wells using InAlGaAs barriers. (NRL)
• Continued achievement of >1% power conversion efficiency in an organic plastic solar cell based on C60 and a transparent hole transporter, and a conducting polymer electrode. (NRL)
• Continued demonstration of mid-IR type-II "W" laser diodes with record external quantum efficiencies (49% at 78K). (NRL)

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- Continued development of technique that suppressed the formation of “killer” GaSb pyramid defects in antimonide superlattice growth. (NRL)
- Continued demonstration of optical coherence in mid-IR 2DDFB lasers with record beam quality for very broad stripes - e.g., 4 times the diffraction limit at w = 400 microns. (NRL)
- Continued development of Adaptive Pulse Compression and Adaptive Pulse Compression Repair Algorithms, which unmask small targets in the presence of large targets and are vastly superior to conventional pulse-compression methods. (NRL)
- Continued efforts in radiation effects studies to determine suitability of electronic components for space application. (NRL)
- Continued the design and fabrication of high performance silicon oscillators. (NRL)
- Completed demonstration of the crossover between the Bardeen-Cooper-Schrieffer and Bose-Einstein condensation phase transitions.
- Completed development of multiple target extraction techniques from single and adjacent range cells to handle unresolved targets. Integrated the extractor in the existing Missile Defense Benchmark for system performance evaluations.
- Completed assessment of impact of field plate technology on scaling of power density of High Electron Mobility Transistors (HEMT) output periphery, broad band matching and reliability.
- Completed demonstration of sub 100 micron cell sized sensor circuitry.
- Completed design and testing of coupled miniature fluxgate magnetometers to improve sensitivity.
- Completed laboratory demonstration of Vertical Magnetic Random Access memory (VMRAM).
- Completed investigations of the ability of many common polymers and crystalline solids to function as permanently recording radiation dosimeters.
- Completed measurements of off-board radiated acoustic pressure from an internally shaker-driven Essex scale model hull. (NRL)
- Completed the development of the theory of robust median adaptive processing and a number of associated processing forms: Median Cascaded Canceller, Multi-stage Median Cascaded Canceller, Reiterative Median Cascaded Canceller, and Loaded Reiterative Median Cascaded Canceller. (NRL)
- Completed the development of the robust FRACTA.E Algorithm for Space-Time Adaptive Processing, a combination of 10 different processing methods, which resulted in an effective solution for detecting signals in highly non-homogeneous and non-stationary interference environments. (NRL)
- Created a new technique for passivation of GaN HEMTs, which resulted in more than an order-of-magnitude increase in device lifetime. (NRL)
- Created a theory for the effective spin de-phasing in quantum dots due to hyperfine interactions with nuclei and predicted de-coherence times on the order of microseconds. (NRL)

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- Modeled electromagnetic behavior of left-handed materials-based waveguiding structures. (NRL)
- Demonstrated 3D high energy laser code for atmospheric propagation (HELCAP) studies in a maritime environment with many physical effects for Navy DEW. (NRL)
- Determined a technique to radiation-harden shallow trench oxides for 150 nm CMOS ICs. (NRL)
- Initiated project to develop linear higher power microwave wide bandgap semiconductor bipolar transistors based on distributed polarization effect (graded composition) base growth and processing technology.
- Initiated creation of techniques for guiding and transporting cooled and trapped rubidium atoms through hollow waveguides. (NRL)
- Initiate the knowledge base for multi-phase array space-time sampling demonstrating that the spectral band can be doubled at no cost in element density for the linear array and for 15% more elements in the planar case. (NRL)
- Initiated research to extend and implement Magnetic Resonance Elastography for low spin density materials. (NRL)
- Initiated development of Nyquist limits for multi-phase array sampling in 4-D spacetime for linear arrays and formulated the problem for planar arrays. (NRL)

FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed above.
- Further development of microcavity gas sensor. (NRL)
- Complete tests of the ability of superconducting analog to digital converters (ADC) to allow digital recovery of 2 distinct signals of arbitrary bandwidth (BW) from a wide spectral analog band with the same clarity as a tuned bandwidth ADC (already proven for case of a single signal in the band).
- Complete research to determine feasibility of locking a laser and etalon to precision frequency standards and generate stable reference optical and microwave frequency lines across a broad spectrum. (NRL)
- Complete investigation of piezoelectric effects in micromachined quantum wells. (NRL)
- Complete increasing the performance of device power conversion efficiency of organic solar cells by optimizing overlap with solar spectrum using highly absorbing dyes and nanocrystals. (NRL)
- Complete development of Inverse Boundary Element methods to reconstruct sources of off-board radiated acoustic pressures. (NRL)
- Complete study to understand the ultimate performance (highest possible Q) of intermediate scale silicon oscillators. (NRL)
- Initiate investigation of superresolution signal processing techniques for closely spaced and unresolved targets in Doppler, range and direction of arrival spaces for a variety of radars.

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- Initiate non-cooperative target identification from multiple aspects.
- Initiate investigation of ultra high speed logic and multiple-quantum-well devices with a goal of >500 giga hertz (GHz) samplers, in support of analog-to-digital conversion, for advanced multifunction RF systems.
- Initiate investigation of physical basis for improved time and frequency standards using quantum-entangled ions and atoms.
- Initiate project to explore physical behavior of full arrays of nanoscale devices for logic, memory, and imaging, with a first step being the integration of Cellular Nonlinear Network (CNN) fast image processor with multi-spectral focal plane array sensors.
- Initiate exploration of functioning of sensitive miniature fluxgate magnetometers.
- Initiate experimental investigations into the bulk thermodynamic properties of phononic crystals. (NRL)
- Initiate investigations into developing highly radiation-tolerant electronic/optoelectronic devices from nanocrystals and quantum dots. (NRL)
- Initiate performing experiments and collecting fundamental data to study electromagnetic scattering from canonical objects undergoing micro-motions. Expand study of mathematical solutions of micro-motion induced Doppler modulations. (NRL)
- Initiate developing waveform/environment interference model that encompasses known waveforms and stochastic information extracted from environment and non-users; investigating known/unknown EM environmental characteristics; and investigating separation/deconvolution of multiple signals. (NRL)
- Pursue methods for preparation, functionalization and characterization of SiC and GaN nanowire surfaces. (NRL)
- Begin the synthesis and modeling of tailored response magneto-dielectric materials. (NRL)
- Perform experiments and collect fundamental data to study electromagnetic scattering from canonical objects undergoing micro-motions. (NRL)
- Determine the radiation-hardening mechanisms related to silicon nanoclusters in oxides. (NRL)

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete determination of the feasibility of quantum cascade 2DDFB lasers with enhanced power and a high-quality beam. (NRL)
- Complete patterning of GaN photonic crystal devices on Silicon. (NRL)
- Complete the evaluation and assessment of hardware-compatible space-time algorithms for DSP applications to T/R arrays. (NRL)
- Complete conduct numerical scattering simulations of canonical objects undergoing micro-motion dynamics and

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compare the results with the Doppler modulations observed. (NRL)
• Complete development of Magnetic Resonance Elastography to characterize low spin density materials. (NRL)
• Initiate monolithic integration of multifunctional materials to enable passive devices and sensors into semiconductor circuits.
• Initiate program to extend device physics and architectures to frequencies approaching tera hertz (THz).
• Initiate program to incorporate Magnesium Diboride (MgB2) and related intermediate temperature superconductors into active electronic device structures.
• Initiate development of stabilized optical sources and low-noise photodetectors for the fabrication of an ultrastable microwave-frequency source. (NRL)
• Determine if the coupling between spins in quantum dots mediated by the virtual excitions is sufficiently strong for use in solid state implementations for quantum information. (NRL)
• Optimize power and efficiency of high power, electron beam pumped Ar-Xe laser for Navy compact DEW. (NRL)

FY 2007 Plans:

• Continue all efforts of FY 2006 less those noted as completed above.
• Complete suite of semiconductor multilayer and superlattice based infrared (IR) sources and sensors in 3-5 micron range.
• Complete exploitation of atom condensates to reach physical limit of frequency precision and control.
• Complete development of bipolar wide bandgap semiconductor linear amplifiers.
• Complete the analysis and characterization of micro-motion Doppler modulation. (NRL)
• Complete investigation of extension of interference model and adaptive structures to produce waveforms that are transparent to non-users. (NRL)
• Complete research into the bulk thermodynamic properties of phononic crystals. (NRL)
• Study the feasibility of a solid state implementation of a quantum computer. (NRL)
• Using the large area plasma processing system (LAPPS), investigate the modification of metal surfaces by nitriding and other processes to maximize hardness, wear and corrosion resistance for Navy gun barrel applications. (NRL)
• Initiate program to apply innovative mass nanofabrication techniques to previously developed nanodevice arrays.

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	FY 2004	FY 2005	FY 2006	FY 2007
WEAPONS	7,089	8,463	8,758	10,530

Efforts include: Undersea Weaponry; Energetic Materials and Propulsion; Expeditionary Operations; Energy Generation, Conversion and Storage. Accomplishments and plans below are examples for each effort category.

Reflects realignment of activities based on CNR requirements.

FY 2004 Accomplishments:

Undersea Weaponry
• Continued conducting basic research related to critical S&T (including vehicle control, maneuverability, and stability) associated with the development of high-speed supercavitating vehicles (HSSV).
• Continued expansion of the University Laboratory Initiative program to provide a further infusion of educated and career minded scientists and engineers in support of the NNR for undersea weapons research.
• Completed conduct of 4-inch powered HSSV test at the Aberdeen Superpond, and assessed the self noise levels of HSSV.
• Completed Visual/Optical approach to determine supercavitating projectile dynamics with its cavity.
• Completed creation of meta-model-Kriging models for performance measurement of potential HSSV designs.
• Completed development of 6 degrees of freedom (6DOF) simulation environment of HSSV motion and trajectories.
• Completed development of 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.
• Completed research of basic science for laser-based passive acoustic arrays.
• Completed expansion of investigation of signal processing algorithms for connectivity between weapons, platforms and off-board sensors.

Energetic Materials and Propulsion
• Continued development of a fundamental understanding of initiation mechanisms of explosive crystals subjected to shock stimulus.
• Continued to develop fundamental understanding of nitramine and perchlorate decomposition mechanisms for propellant applications.

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• Continued to develop spectroscopic capabilities to accurately determine aluminum combustion characteristics in various oxidizing environments.
• Continued to develop synthesis routes to difluoramino-based and organometallic-based highly energetic ingredients.
• Continued exploring the use of quantum mechanics and molecular dynamics to provide fundamental properties for energetic materials to predict initiation/detonation criteria for insensitive munitions applications.
• Completed demonstration of passive combustion control of supersonic and subsonic flows to reduce combustion instability and pressure oscillations and to improve performance, while reducing emissions.
• Completed demonstration of cyclic pulse detonation of single tube combustor for pulse detention engine (PDE) operation with JP-10 fuel.
• Completed numerical simulations of multi-tube multi-cycle PDE operation with nozzles.
• Completed performance evaluation of PDE technology for operation on logistics fuels.
• Completed synthesis and characterization of new energetic materials with higher energy density and acceptable sensitivity.
• Initiate efforts to explore alternative fuel concepts for naval applications to include hydrogen, synthetic diesel, and biodiesel.

Expeditionary Operations
• Demonstrated that seismic Rayleigh waves can be used to generate detectable resonances in anti-personnel landmines buried in a wide range of soil types.

Energy Generation, Conversion, and Storage
• Continued analyzing synchronization of 19 diode lasers to produce intense beams.
• Continued conducting preliminary studies on multivalent ion insertion in nanoscale vanadium pentoxide cathode materials to improve the capacity of rechargeable lithium batteries.
• Continued development of nanostructured electrode and polymer electrolyte materials for electrochemical power sources.
• Continued improvements to catalyzed carbon microfiber electrode development for semi-fuel cells.
• Continued work on developing the scientific basis of nanostructure enhancement of direct energy conversion materials performance for power generation.
• Continued design of a thermoacoustic piezoelectric generator working via a temperature gradient.
• Continued development of materials for enabling rechargeable batteries with an energy density approaching 500 watt-hours per kilogram.
• Continued expanding the fundamental understanding of direct electrochemical oxidation in solid oxide fuel

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cells and the use of logistic fuels.
• Continued expanding research into new materials and processes for converting thermal to electric energy.
• Continued identification of record high figure of merit bulk thermoelectric material for power generation.
• Initiated identification of new approaches to efficiently transfer thermal, electrical and optical energy from primary sources.
• Initiated research in materials and processes for novel concepts in efficient energy conversion.

FY 2005 Plans:

Undersea Weaponry
• Continue all efforts of FY 2004 less those noted as completed above.
• Initiate conduct of computer code refinements and investigation of supercavitating vehicle dynamics and instability.

Energetic Materials and Propulsion
• Continue all efforts of FY 2004 less those noted as completed above.
• Complete work on quantification of active combustion control.
• Initiate development of multi-parameter sensor for multi-phase combustion flows (UAV and underwater PDEs).
• Initiate investigation of JP-10 combustion-based Proton-Exchange-Membrane (PEM) fuel cells.
• Initiate investigation of multi-tube multi-nozzle PDEs and multi-tube common nozzle PDEs.
• Initiate investigation of nanometallic-hydrocarbon hybrid catalytic combustion for increased energy release rates.
• Initiate investigation of novel initiation techniques, optimize injection parameters, and demonstrate integrated single tube operation for PDEs.
• Initiate PDM II Advanced Energetics research in reactive, explosive, and propulsive energetic materials, including high energy ingredient synthesis & characterization, and fundamentals of initiation and decomposition mechanisms, to tailor energy release processes in order to achieve substantial performance gains and/or enhanced survivability in harsh environments.

Expeditionary Operations
• Continue all efforts of FY 2004.
• Investigate modeling and exploiting the nonlinear seismic interactions between buried land mines and their surrounding soil for purposes of landmine detection.
• Investigate catalysts that reduce the pre-processing requirements for using logistic fuels in solid oxide

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fuel cells.
• Synchronize coupled diode laser arrays.

Energy Generation, Conversion, and Storage
• Continue all efforts of FY 2004 less those noted as completed above.

FY 2006 Plans:

Undersea Weaponry
• Continue all efforts of FY 2005 less those noted as completed above.
• Initiate evaluation of viable synthesis methodologies and characterize emerging underwater explosive ingredients.
• Initiate development of diagnostic capabilities to accurately determine aluminum combustion characteristics in oxidizing environments.

Energetic Materials and Propulsion
• Continue all efforts of FY 2005 less those noted as completed above.
• Initiate implementation of new & nanostructured materials design concepts for direct energy conversion and waste energy conversion.
• Initiate investigation of integrated pulse detonation engine-airframe for autonomous vehicles, and pulse detonation for passive weapons (noise, jamming).

Expeditionary Operations
• Continue all efforts of FY 2005.

Energy Generation, Conversion, and Storage
• Continue all efforts of FY 2005 less those noted as completed above.

FY 2007 Plans:

Undersea Weaponry
• Continue all efforts of FY 2006 less those noted as completed above.

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Energetic Materials and Propulsion
- Continue all efforts of FY 2006 less those noted as completed above.
- Initiate development of PDE for underwater applications.

Expeditionary Operations
- Continue all efforts of FY 2006.

Energy Generation, Conversion, and Storage
- Continue all efforts of FY 2006 less those noted as completed above.

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
ACADEMY FOR CLOSING AND AVOIDING ACHIEVEMENT GAPS	961	990

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

FY 2005 Plans:
- Basic research to examine methods of determining college students' strengths and weaknesses in sciences and tailor a program to improve in these gaps.

	FY 2004	FY 2005
BRAIN-BASED INTELLIGENT SYSTEM	0	1,982

Investigate the design of embedded low-power, self-instructing computational systems through architecture studies, analysis, and experimentation. If the research is successful, with subsequent development, these systems could be utilized for Navy applications that could improve human performance, increase training capabilities, and enhance human communication. The design of the proposed computational device is based on the emulation of neuroanatomy and the dynamics known to be present in the brain.

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FY 2005 Plans:
• Initiate a program to explore the circuit architectures of an array of neural cores which will replicate the functional elements of the brain and its interconnectivities. Configure these architectures to respond to a variety of signals without the need for prior specific programming or instruction.

	FY 2004	FY 2005
CENTER FOR PHOTOCHEMICAL SCIENCES	482	0

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

FY 2004 Accomplishments:
• Initiated work on a novel approach to encourage the cure front in a photocured coating to propagate into dark regions obscured from photo-initiation.

FY 2005 Plans:
• Continue by expanding the previous effort to allow development of very low or no volatile organic compound (VOC) coatings for ship hulls and carrier decks.

	FY 2004	FY 2005
FACIAL RECOGNITION TECHNOLOGY RESEARCH AND DEVELOPMENT	0	1,585

Research and development of facial recognition technology for security application at entry locations on US military bases and facilities.

FY 2005 Plans:
• Initiate research to combine advanced face recognition technology with a novel skin texture metric in order to develop a highly accurate and robust face biometric to verify the identity of personnel entry a DoD facility.
• Validate research by measuring accuracy and speed of this technology for identification of personnel within vehicles who enter a smart gate.

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	FY 2004	FY 2005
HYDROGEN FOR FUEL CELLS	0	990

Research into hydrogen generation for use as fuel for electricity production by environmentally-friendly fuel cells.

FY 2005 Plans:
• Initiate efforts to design, implement and test new catalysts for hydrogen evolution from alcohols and other biofeedstocks under ambient conditions of temperature and pressure.

	FY 2004	FY 2005
INTEGRATED WMD DETECTION AND COLLECTION SYSTEM	2,017	0

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

FY 2004 Accomplishments:
• Completed a baseline “Tradeoff Analysis” (TOA) study which will compare and analyze requirements and available capabilities of Chemical/Biological/Radiological/Nuclear (CBRN) threat detection technologies.
• Completed evaluation and selection of the optimum technical approach to achieve the objective system. Designed a prototype CBRN system suitable for UAV, ground vehicle and stand alone implementations.

	FY 2004	FY 2005
INTELLIGENT AUTONOMOUS NETWORKS & SYSTEMS (AINS)	0	990

Commercialization of Ad Hoc Routing Protocols to develop an initial product capability delivering a network connection device for Class 2 UAV platforms within 18 months. This communication system will be positioned to support multiple types of Unmanned Vehicles.

FY 2005 Plans:
• Initiate commercialization of Ad Hoc Routing Protocols to develop an initial product capability delivering a network connection device for Class 2 UAV platforms.

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	FY 2004	FY 2005
NANOSCALE ARCHITECTURES FROM PROTEIN NANOCAGES	1,923	0

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

FY 2004 Accomplishments:
• Established a multidisciplinary research center, the Center for Bio-Inspired Nanomaterials (CBIN), which focuses on research aimed at understanding and utilizing nanoscale architectures based on protein cages.

	FY 2004	FY 2005
NEUTRON DETECTOR	961	0

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

FY 2004 Accomplishments:
• Completed research and testing to improve the solid state neutron detector gain by factor of 100, efficiency by a factor of 10, and energy range of the detected neutrons by a factor of 100 as compared to current technology.
• Completed design of CMOS interface circuitry to the detector.

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	FY 2004	FY 2005
QUANTUM OPTICAL SCIENCE AND ENGINEERING	2,408	0

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. Light Detection And Ranging (LIDAR) based measurements employing Brillouin scattering allows for determining ocean sound speed depth profiles.

FY 2004 Accomplishments:
• Completed construct of mid/far-infrared semiconductor lasers based on resonant stimulated Raman scattering in quantum cascade lasers to operate as injection-pumped tunable lasers generating up to 1 watt of power in Raman lasing modes.
• Completed measurement of the determination of the dependence of Brillouin shifts (using iodine absorption lines) on temperature and sound speed in fresh water.

	FY 2004	FY 2005
ROBOTIC COUNTERMINE TECHNOLOGIES	1,923	0

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

FY 2004 Accomplishments:
• Completed modification of the current robot design to improve stability and maneuverability.
• Completed reconfiguration of the battery location, redesigned the leg assemblies.

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	FY 2004	FY 2005
UNOLS RESEARCH VESSEL	0	1,784

Acoustical studies in the Littoral zone have been seriously hampered by interference from noise caused by shipboard machinery and propulsion equipment and radiated through the hull of the vessel. At the present there are no United States research vessels which meet the International Council for Exploration of the Seas (ICES) 209 standard (radiated noise standard for research vessels). UNOLS vessels have been extensively used by NRL and ONR funded investigators to conduct such studies. This funding will be used to provide augmentation for propulsion and machinery quieting for the University of Delaware vessel presently under construction in order to provide enhanced capability for Navy investigators.

FY 2005 Plans:
• Initiate efforts to identify potential noise sources and implement ameliorating strategies to meet ICES standards.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0601152N In-House Laboratory Independent Research
PE 0601103N University Research Initiatives

NON-NAVY RELATED RDT&E:
PE 0601102A Defense Research Sciences (Army)
PE 0601101E Defense Research Sciences (DARPA)
PE 0601102F Defense Research Sciences (Air Force)

D. ACQUISITION STRATEGY:
Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N
PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
POWER PROJECTION APPLIED RESEARCH	141,450	135,163	94,148	73,926	65,778	57,165	45,886	57,276

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

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

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N
PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	142,626	98,831	89,335	81,799
Cong Rescissions/Adjustments/Undist. Reductions	0	-1,360	0	0
Congressional Action	0	39,600	0	0
Program Adjustments	0	-1,908	4,879	-10,802
Execution Adjustments	334	0	0	0
Federal Technology Transfer	-31	0	0	0
FNC Realignment	0	0	-125	2,550
Non-Pay Inflation Adjustments	-140	0	2	3
Rate Adjustments	0	0	57	376
SBIR Assessment	-1,339	0	0	0
FY 2006/2007 President's Budget Submission	141,450	135,163	94,148	73,926

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602114N PROGRAM ELEMENT TITLE: POWER PROJECTION APPLIED RESEARCH
PROJECT TITLE: POWER PROJECTION APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
POWER PROJECTION APPLIED RESEARCH	141,450	135,163	94,148	73,926	65,778	57,165	45,886	57,276

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

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
STRATEGIC SUSTAINMENT	23,120	29,852	23,319	13,447

The Strategic Sustainment activity develops technologies which will sustain and improve Navy's strategic system capabilities in the areas of Radiation Hardened System Design (RAD HARD), Solid Rocket Motor Ignition (SRM) Response, and drag reduction devices. This activity contains the Technology for the Sustainment of Strategic Systems (TSSS) and the Strategic Systems Infrastructure (SSI) effort. Increase in 2005 was due to the addition of tasks for the SSI effort. Decreases in FY 2006 and FY 2007 are due primarily to completion of TSSS Phase 1 effort.

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FY 2004 Accomplishments:

- TSSS: RAD HARD task continued efforts in upgrading and linking software. The SRM ignition response effort performed advanced nonlinear model comparisons with ground test data. Drag Reduction Devices developed an advanced aerospike drag reduction model. The accelerometer effort fabricated a Proof of Concept Superconducting and Atom Interferometer and Gravity Gradient Sensor.
- SSI: Initiated formulation of high performance propellants, development of the preliminary design and parametric testing for a Post Boost Control System (PBCS). Performed preliminary design of alternatives for an Exploding Bridgewire (EBW) detonator and conducted evaluation of test data of the effects of the external environment on missile electronics. Began transition of ONR's advanced transducer design and developed a new hydrophone array.

FY 2005 Plans:

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

FY 2006 Plans:

- TSSS: Underwater launch task will conduct exit testing of the Underwater Launch Technology Sustainment System (ULTSS). Testing will be performed to demonstrate the utility of the ULTSS in guiding and advising engineers unfamiliar with Underwater Launch (UWL) technology in the creation of a conceptual design. Release of final version of ULTSS. The TSSS Phase I effort is completed.

- SSI: Missile tasks in Propulsion will continue efforts by conducting non-eroding throat tests, chamber bottle tests, insulator tests, component compatibility tests and propellant hazard assessment. The program

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will conduct an innovative testing of new rocket motor case/nozzle design. Continue Advanced PBCS Valve efforts by conducting materials compatibility tests, an Integrated Valve Assembly demo, subscale propellant mixes and a manifold concept demo. Ordnance Initiation Technologies program will test the ordnance initiation system as a laboratory prototype. Continue Missile Electronics efforts by conducting small coupon aging studies, conduct radiation hardening tests & assessments, complete board aging model development, and continue development of board level and missile level modeling techniques. Sonar effort will complete detailed design and begin fabrication of the prototype new technology hardware.

FY 2007 Plans:

- SSI: Continue Missile propulsion efforts by conducting larger scale non-eroding throat tests, chamber bottle tests, insulator tests, component compatibility tests and propellant hazard assessment. Continue Advanced PBCS Valve Technology and Materials program efforts by conducting materials compatibility tests, Integrated Valve Assembly demo, subscale propellant mixes and a manifold concept demo. Goal is heavy wall testing simulating a very limited full scale Post Boost control system test. Ordnance Initiation Technologies program completes final tests on the prototype demonstrating the new technology, with documentation of designs showing applications to strategic missiles. The Missile Electronics Technologies program completes code development with final Validation and Verification of the models with experimental radiation hard data and aging data. Navigation sonar will complete Laboratory and tank testing of the new technology transducer and hydrophones. Prototype hardware will be integrated aboard USNS WATERS to provide a Navigation Sonar System (NSS) test bed and evaluated at-sea in an operational environment.

	FY 2004	FY 2005	FY 2006	FY 2007
HIGH SPEED PROPULSION AND ADVANCED WEAPON TECHNOLOGIES	16,949	36,046	17,118	14,257

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

The increase from FY 2004 to FY 2005 was due to increased funding for the National Aerospace Initiative (NAI) high speed propulsion effort. The decrease in FY 2006 reflects conclusion of Hy Fly, reduced 6.2 effort in NAI Hypersonic Turbine Vehicle (HTC), and transfer of Non-Lethal Weapons to PE 0602651M.

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FY 2004 Accomplishments:

- HyFly: Continued air vehicle and fuel system testing and validation of the operational flight program software using hardware in-the-loop testing.
- Integrated High Payoff Rocket Propulsion Technology (IHPRPT): Continued development of surface launch component technologies.
- Asymmetric Threat Defense: Continued subsystem design and development of detection/tracking algorithms and components for the Ship-Linked Interceptor (SLI) and Laser Anointed Interceptor (LAI) including the Inertial Measurement Unit (IMU), warhead, fuzing, explosive, control actuators, and signal processing algorithms.
- National Aerospace Initiative High Supersonic Turbine Vehicle (NAI HSTV) technology base: Program supported the development of high-speed supersonic turbine engine and airframe technologies for expendable weapons applications. Initiated flow path and turbine engine component development and demonstration effort to increase the performance of inlet and nozzles, high temperature compressor, and turbine.

FY 2005 Plans:

- HyFly: Conduct direct connect tests and a freejet test to optimize engine performance.
- IHPRPT: Continue surface launch component development and begin initial design for the air launched demonstration effort.
- Asymmetric Threat Defense: Continue development of detection and continuous target tracking algorithms. Continue design and fabrication of the SLI and LAI.
- NAI HSTV: Continue development and validation of flow path and turbine engine components and continue component rig testing. Begin design and fabrication of airframe components and assessment of thermal management techniques.
- Non-Lethal Weapons: This program has been transferred to PE 0602651M.

FY 2006 Plans:

- IHPRPT: Design, assess and process new energetic material ingredients for advanced composite rocket motor development. Demonstrate end burning propellant grain, survivable nozzle and high pressure composite case air-to-air rocket motor. Demonstrate Phase II performance goals in 5.2-inch end burning, flight-weight motor.
- Asymmetric Threat Defense: Design and fabricate seeker, fuze and warhead prototypes.

BUDGET ACTIVITY: 02
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- NAI HSTV: Continue development of component/sub-system technologies in propulsion, inlet, nozzle, airframe, and thermal management for high supersonic turbine powered weapon systems. Select technologies for validation and conduct ground testing/validation.

FY 2007 Plans:

- IHPRPT: Scale-up and formulate new propellant ingredients and compositions. Eliminate nozzle erosion commensurate with ducting, acceleration and exhaust of high temperature solid propellant gases and particulates. Demonstrate impulse performance gains of >5% through low-to-zero erosion nozzle concepts.
- Asymmetric Threat Defense: Demonstrate seeker performance with captive carry flight over water. Demonstrate fuze and warhead performance against static boat targets.
- NAI HSTV: Continue development of component/sub-system technologies for high supersonic turbine powered weapon systems. Conduct validation, ground testing and demonstrations.

	FY 2004	FY 2005	FY 2006	FY 2007
UNMANNED VEHICLES	14,604	9,258	6,439	8,099

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

FY 2004 Accomplishments:

- UAV radar: Completed airborne testing using a Piper Aztec as a surrogate platform.
- IA: Continued development of dynamic replanning and autonomous control and operations technologies. Completed UAV/UGV reconnaissance demonstration jointly with Defense Advanced Research Projects Agency (DARPA) and in-water maritime situation awareness demonstration.
- UUV: Continued development of Electro Magnetic/Electro Optic (EM/EO) sensors, software, sensor data fusion, integrated autonomous control approaches for Maritime Reconnaissance (MR), and multi-vehicle Undersea Search and Surveillance (USS) and communication link development.

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- UAV control: Continued testing of threat detection/collision avoidance software and the development of secure jam resistant communications and multiple UAV information displays.
- UGV: Continued development of robotic communication technologies in support of the Marine Corps Gladiator Tactical Unmanned Ground Vehicle (TUGV) program; transitioned them to the Marine Corps for System Design and Development(SDD).
- UAV propulsion: Continued development fabrication and rig testing of Navy UAV propulsion component technologies under the Integrated High Performance Turbine Engine technology (IHPTET) program, including the advanced PW-800 commercial gas generator core and the XTL-17 supersonic missile engine.
- Autonomous Mobile Platform (AMP): Initiated effort to create small sensor platforms capable of extended endurance. Developed propulsion/energy storage/replenishment, navigation/guidance systems, and locomotion technologies.
- Developed four configurations of the Survivable Mobile, Long Endurance (vehicles that will allow small sensor platforms to rejuvenate their power source and to reposition themselves as required. (NRL)
- Continued development of high-performance, low-cost Electro-Optic/Infrared (EO/IR) airborne surveillance sensors for unmanned aerial vehicles, and ultra-high performance EO/IR sensors. (NRL)

FY 2005 Plans:

-IA: Continue development of dynamic replanning and autonomous control technologies. Conduct simulation of dynamic replanning and multi-vehicle technology for littoral Intelligence Surveillance & Reconnaissance (ISR). Complete simulation demonstration of multi-vehicle distributed cooperative control jointly with Air Force for Intelligence Surveillance & Reconnaissance (ISR) and strike missions. Complete joint DARPA UAV/UGV reconnaissance demonstration.
- UUV: Continue development and transition of UUV-deployed ISR EM/EO sensors and software, multi-vehicle USS and communication link development; continue Magnesium Semi-Fuel Cell energy source development and demonstration. Complete preparation of transition data package for the Integrated Motor Propulsor(IMP).
- UAV control: Continue development of command, control and displays for multiple UAVs, and single frequency multi-point UAV communications.
- UAV propulsion: Ground test demonstrator engine and a Mach 3.5 capable expendable turbine engine.
- AMP: Integrate energy replenishment and storage with a mobile platform and demonstrate replenishment and relocation operation.
- Integrate energy replenishment and storage mechanism in small autonomous vehicles and demonstrate replenishment and relocation. (NRL)
- Complete development of high performance EO/IR sensors for UAV's. (NRL)

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- Initiate development of a lightweight, 4.5 hp recuperated, turbo-shaft engine with an integral 3 kW generator for UAV propulsion and portable power generation. (NRL)

FY 2006 Plans:

- IA: Complete development of multi-vehicle cooperation technologies. Complete medium-fidelity simulation of multi-vehicle cooperation technologies for multiple classes of Naval unmanned vehicles in littoral ISR.
- UUV: Transition USS and Communications Navigation Aid (CNA) products to PMS-Explosive Ordnance Disposal (EOD) and ONI-34 per Technology Transition Agreements (TTAs); standup Submarine Track and Trail (STT) efforts in the areas of advanced undersea sensors, communications, and autonomy.
- UAV control: Continue developing and testing airborne and shipboard battle manager platforms for UAVs operating from Littoral Combat Ship (LCS) ships. Continue developing and begin testing an open architecture airborne control station that can be used onboard a P-3 type aircraft for the control of multiple UAVs.
- UAV propulsion: Continue Ground test demonstrator engine and a Mach 3.5 capable expendable turbine engine.
- Continue development of lightweight UAV engine. (NRL)

FY 2007 Plans:

- UUV: Continue STT efforts in the areas of advanced undersea sensors, communications, and autonomy.
- UAV control: Continue developing and testing airborne and shipboard battle manager platforms for UAVs operating from LCS. Continue testing an open architecture airborne control station that can be used onboard a P-3 type aircraft for the control of multiple UAVs.
- UAV propulsion: Continue Ground test demonstrator engine and a Mach 3.5 capable expendable turbine engine.
- Complete long-term demonstration of multiple sensor-equipped vehicles, covering autonomous sensing operation and multiple replenishment/relocation cycles under autonomous or semi-autonomous control. (NRL)

	FY 2004	FY 2005	FY 2006	FY 2007
NAVIGATION, ELECTRO OPTIC/INFRARED (EO/IR), AND SENSOR TECHNOLOGIES	13,310	6,928	6,983	7,052

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

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includes NRL investment/performance in the technology areas of Electronics, Electronic Warfare, and Communications.

FY 2004 Accomplishments:

- Tightly Coupled Global Positioning System/Inertial Navigation System (GPS/INS): Incorporated Micro Electronic Mechanical Systems (MEMS) IMU into existing test bed. Completed zero-age ephemeris and Controlled Radiation Pattern Antenna (CRPA) mutual coupling reduction projects.
- EO/IR technologies: Multispectral Infrared Focal Plane Array (IRFPA)- Developed two color longwave focal plane based algorithms for missile defense. Continued development of high-performance, low-cost Electro-Optic/Infrared (EO/IR) airborne surveillance sensors for unmanned aerial vehicles, and ultra-high performance EO/IR Imagers. Continued work to develop auto-target identification techniques for Laser Range-gated imagers.
- Navigation Technologies: Continued Distributed Time Standards, Rb Double Bubble Maser Atomic Clock, time synchronization and precision time transfer, and algorithm development for Distributed Time Scaling efforts. Initiated GPS/INS/LORAN effort to remove noise and improve GPS and LORAN performance.
- Millimeter Wave (MMW) threat detection: Initiated effort to develop preliminary hardware and software designs for channelized and photonic Ka/W band Electronic Warfare (EW) receiver designs.
- Electronics: Continued development of system simulation tool in ZEMAX and tested spectral emittance based target discrimination algorithm for three band Long Wave Infrared (LWIR) sensor. Continued effort with demonstration of the first long wave IR (LWIR) “W”-structured type-II superlattice (WSL) photo-diodes. These devices exhibited stronger absorption and turn-on than comparable binary and ternary antimonide superlattice photodiodes. Designed WSL based heterostructure for dual-band photodiodes, and completed dual-band test maskset. Continued identification of the correlation between arsenic background pressure and cross-contamination of arsenic in GaSb layers and interfaces in InAs/GaSb superlattices using cross-sectional tunneling electron microscopy (XSTM) and x-ray diffraction (XRD). Initiated design of Photonic Band Gap (PBG) structures for infrared (IR) transmission and demonstrated feasibility to extrude micro-structured performs and have drawn preliminary Hollow Core (HC)-PBG fiber. (NRL)
- Electronic Warfare: Continued development of infrared countermeasures (IRCM) against imaging missiles using a unique state-of-the-art hardware-in-the-loop hybrid approach. Initiated development of IR obscuration technologies using evolving nanoparticle technology to provide surface vessel protection to achieve an order of magnitude improvement over current obscurants. (NRL)

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- Communications: Continued development and conducted demonstrations for operational forces of covert, high bandwidth, free space laser communications systems. Continued development of Multi-Quantum Well (MQW) retroreflector covert communications system. Increase bandwidth by order of magnitude using a cat's eye backplane. (NRL)

FY 2005 Plans:

- Navigation Technologies: Continue Precision Time and Time Interface transfer demonstration, Deeply Coupled GPS/INS with nonlinear filter algorithm development, Distributed Time scaling Technology, Rb Double Bubble Maser Atomic Clock, and static testing of Tightly Coupled GPS/INS/Loran projects. Initiate the following four projects: MEMS INS device development, Communication Navigation and Identification (CNI) device, GPS receiver for landing systems, and Space and Frequency Adaptive Processing for GPS Anti-Jam (AJ) antennas.
- EO/IR technologies: Continue Multispectral IRFPA assembly and testing, and fabrication of photonic MMW threat detection prototype receivers. Continue development of high-performance, low-cost EO/IR airborne surveillance sensors for unmanned aerial vehicles, and ultra-high performance EO/IR Imagers. Continue development of auto-target identification techniques for Laser Range-gated imagers.
- Electronics: Continue spectral emittance based target discrimination work, LWIR WSL development, GaSb substrate study, and high power laser HC-PBG effort. Initiate study Yb doped ceramic YAG and Y2O3 for optical cooling efficiency, investigate high power 1030 nm lasers as a pump source. (NRL)
- Electronic Warfare: Complete IRCM effort by implementing preprocessing and track algorithms into imaging seeker surrogates. Continue IR obscurant technology development. (NRL)
- Communications: Continue covert high bandwidth communications and MQW retroreflector communications system efforts. (NRL)

FY 2006 Plans:

- Navigation Technologies: Continue Distributed Time Standards algorithm development, Rb Clock design and experiments, and Link 16 Time Transfer development and testing. Continue Tightly Coupled GPS/INS/LORAN effort, Fiber Optic Ring Gyroscope development, algorithm development for GPS Anti-Jam (AJ) and direction finding. Complete Algorithm development for Distributed Time Scaling and the Deeply Integrated GPS/INS width Nonlinear Filter project. Initiate the Magnetic Passive Reset for Inertial Navigation System (INS) and the development of Advanced GPS/INS (GIN) Systems for Strike Weapons.
- EO/IR: Continue Jitter Compensation development of low cost piezoelectric motion and jitter compensation for high resolution visible and infrared sensors. Millimeter Wave (MMW) and TeraHertz (THz) Imaging effort

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will complete development of MMW imagers and continue development of THz imaging through fog, clouds, clothing, and some walls. Continue Nano Sensors development of ultra low noise uncooled nanotechnology infrared sensors and nanoatomic sensor nonvolatile memories. Electronic Zoom effort will continue development of electronic liquid crystal based directional field of view and zoom imagers. Continue multi-sensor (visible, infrared, millimeter wavelength, terahertz and laser imagers) fusion for objection recognition.
- Electronics: Continue high power HC-PBG development and Yb doped ceramic YAG high power laser efforts. Complete target discrimination effort by conducting a real time demonstration of spectral emmitance based target/material target descrimination using LW QWIP sensor. Complete study of WSLs for multiband IR photodiodes by demonstrating high performance dual-band LW & VLIR photodiode operation. Complete study of pre-growth molecular hydrogen cleaning of GaSb substrates. (NRL)
- Electronic Warfare: Continue IR obscurant technology development effort. (NRL)
- Communications: Continue covert high bandwidth communications effort. Complete development of MQW retroreflector with Cat's Eye Backplane. Transition compact, light-weight MQW communications to operational forces. (NRL)

FY 2007 Plans:

- Navigation Technologies: Continue Rb Clock development and testing, Fiber Optic Ring Gyroscope development, GPS AJ and Direction Finding algorithm development, Magnetic Passive reset for INS, and Advanced GPS/INS systems for strike weapons. Complete Network Centric Navigation (Link-16 Time Transfer), Distributed Time Standards, and Tightly Coupled GPS/INS/Loran efforts.
- EO/IR: Complete development of low cost piezoelectric motion and jitter compensation for high resolution visible and infrared sensors. Continue Millimeter Wave (MMW) and TeraHertz (THz) Imaging project. Complete development of ultra low noise uncooled nanotechnology infrared sensors and continue development nanoatomic sensor nonvolatile memories. Complete development of electronic liquid crystal based directional field of view and zoom imagers. Complete multi-sensor (visible, infrared, millimeter wavelength, terahertz and laser imagers) fusion for objection recognition effort.
- Electronics: Complete demonstration of high laser power through IR transmitting HC-PBG fiber. Complete performance optimization and scaling law development for the Radiation Balanced Laser. (NRL)
- Electronic Warfare: Complete development of IR obscuration technologies for surface vessel protection to achieve order of magnitude improvement over current obscurants and develop dissemination system prototype. (NRL)
- Communications: Continue development of free space laser communications systems with the development of a hybrid infrared system with dramatically lower power requirements at the sensor/transmitter. (NRL)

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	FY 2004	FY 2005	FY 2006	FY 2007
ELECTRIC WEAPONS	13,452	9,898	38,632	30,328

The goal of this activity is to develop Directed Energy (DE) and Electric Propulsion power weapons for Navy applications. One major component of the DE program is the Free Electron Laser (FEL) which if successful could be applicable for shipboard applications as a defense weapon against advanced cruise missiles and asymmetric threats. The other major component is the EM gun work that is focused on developing the technology to launch a long range projectile from Navy ships. This activity also includes NRL investment/performance in these research areas.

FY 2004 Accomplishments:

- DE: Completed commissioning and demonstration of a 10 kW FEL. Performed FEL beam quality experiments at the 10 kW level and conducted design studies for advanced injector configurations. Initiated design studies to evaluate multiple design alternatives and costs involved with the development, fabrication, and demonstration of a 100 kW FEL.
- EM gun: Initiated program to develop EM gun technology. Initial effort focused on rail wear issues, energy storage, and pulsed power switching. Demonstrated 90mm prototype in initial lethality tests against different strike targets.

FY 2005 Plans:

- DE: Continues with fabrication of high current, high brightness injectors including superconducting Radio Frequency (RF) cavity base design. Conduct experiments with alternative FEL amplifier configurations to compare performance to current oscillator configuration and to determine the best scale up path to a megawatt FEL.
- Investigate tribologic aspects of sliding metal-to-metal high current contacts in the rails of EM railguns. (NRL)

FY 2006 Plans:

- DE: Perform 1 micron filamentation, halo limitation, and short Rayleigh range studies. Continue lethality testing and optical propagation studies. Current injector task will complete assembly and test the Advanced Energy Systems (AES) Cryounit. Continue testing of radio frequency (RF) gun High Voltage Power Supply (HVPS)

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components which are required for the 100 kW high current injector. Install HVPS gun and commission HVPS. Begin gun performance tests and 750 MHz cryounit integration. FEL development effort will continue 750 MHz cryomodule design, complete facility upgrade for 100 kW FEL development, and begin cryomodule construction.
- EM gun: Develop technology for Full Scale Proof of Concept Demonstrator for testing of integrated launch package (ILP) in 2009. Conduct investigation of improved rail gun rail wear techniques. Conduct testing of capacitor based pulse forming network system to 32 megajoules (of 200 required) of stored power with prototypical rail gun system increasing in power level and projectile speed, while examining rail/bore life issues expected to be seen at larger scale.
- Pursue superior designs of insulators to handle the thermal and mechanical shocks generated by the launch in EM railguns. (NRL)
- Create and develop novel electric weapon architectures and designs that enhance performance and maintainability. (NRL)

FY 2007 Plans:

- DE: Complete gun performance tests. Complete 750 MHz Cryounit integration and low power characterization. FEL development task will complete cryomodule design. Continue cryomodule construction.
- EM Gun: Continue examination of rail/bore life issues expected to be seen at larger scale. Complete Heat Transfer and Heat Management analysis. Conduct analysis of Dynamic Load Sharing of High Power Electrical Distribution Bus architecture. Complete initial high power switching demonstration required for electrical pulse forming network (PFN). Assess electromagnetic noise to nearby power systems and electronics systems.
- Investigate surface treatments such as advanced coatings or "MAX-phase" materials to harden the rails in electromagnetic railguns. (NRL)
- Develop designs of viable novel electric weapon architectures that enhance performance and maintainability. (NRL)

	FY 2004	FY 2005	FY 2006	FY 2007
STRIKE TECHNOLOGIES	5,438	3,959	1,657	743

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. NRL investment/performance in this effort are included.

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FY 2004 Accomplishments:

- Enhanced Target Acquisition and Locating System (ETALS): Completed development of the mechanical, electrical, and software interfaces between the Miniature Azimuth Gyrocompass Unit-1 (MAGU-1) and the Target Location Designation and Handoff System (TLDHS) Lightweight Laser Designator/Rangefinder (LLDR). Conducted operational testing of the MAGU-1 to verify that it is suitable for the planned replacement for the AN/GVS-5.
- Advanced Gun Barrel (AGB) & Seeker Technology: Continued development of refractory materials, coating/liner application processes, metal matrix composites, and integration into two advanced barrel concepts for use on the DD(X) ship.
- Initiated investigation of wide bandwidth amplifier technology for decoy applications. Investigate arrays of passive reflectors to provide a distributed Radar Cross Section (RCS) at W-band. (NRL)

FY 2005 Plans:

- AGB & Seeker Technology: Continue work necessary for full scale fabrication of a prototype 155mm gun barrel with advanced interior. Develop and test advanced functionally graded composite material designs and fabricate a composite barrel test section. Complete development of advanced missile guidance technology and automatic target recognition / targeting for time sensitive targets.
- Initiate the development of improved processing algorithms for integration into existing Synthetic Aperture Radar (SAR) image formation processors to enhance the resolution of SAR data. (NRL)
- Initiate development and demonstration of image-while-scan (IWS) technologies needed to perform imaging and identification of targets of radars operating in non-spotlight mode. (NRL)
- Continue wide bandwidth amplifier development. (NRL)

FY 2006 Plans:

- Hand Held Precision Targeting: Complete development of the rangefinder module including integration of an inertial measurement unit (IMU) and magnetometer. This will allow the forward observer to use a laser range finder for target designation in a magnetically hostile environment.
- AGB & Seeker Technology: Continue Advanced Gun barrel technology prototype development.
- Continue SAR algorithm development, IWS technology development, and wide bandwidth amplifier development. (NRL)

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FY 2007 Plans:

- AGB & Seeker Technology: Complete with testing of full scale advanced gun barrel technology prototype using multiple projectile test firings.
- Continue IWS technology development. (NRL)
- Complete SAR algorithm work by incorporating algorithmic tools into existing SAR system for testing. (NRL)
- Complete wide bandwidth amplifier effort by testing evaluating candidate decoys against W-band radars. (NRL)

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
ADVANCED DEVELOPMENT AND DEMONSTRATION OF ELECTRIC ACTUATOR TECH	1,154	0

Prototype electric actuators was developed and tested. An assessment of the suitability of electric actuators to replace the present hydraulic actuators for shipboard use was conducted.

	FY 2004	FY 2005
ADVANCED HIGH-ENERGY THERMOBARIC WARHEAD DEVELOPMENT	0	990

This effort will configure and demonstrate an advanced high-energy thermobaric explosive composition that will provide enhanced internal blast pressures and moderate thermal effects in confined environments for the M72 LAW (Light Anti-tank Weapon) ASM. Primary efforts include fuze development and booster testing.

	FY 2004	FY 2005
ADVANCED HYBRID STORED ENERGY DEVICES FOR AFFORDABLE AIR WEAPONRY	0	1,485

Effort supports Advanced Hybrid Stored Energy Devices for Affordable Air Weaponry.

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	FY 2004	FY 2005
ADVANCED MULTI-INT EXPLOITATION SYSTEMS (AMIES)	2,698	0

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

	FY 2004	FY 2005
ADVANCED REACTIVE MATERIAL ENHANCED NANOCOMPOSITE WARHEADS (ARMENW)	2,485	2,575

This effort supported the manufacturing technology development and production scale up of high density nano material composites used in the construction of advanced warheads for air and surface weapons. FY04 – Formulated new nano metal and metal oxide materials and compositions enhancing ordnance abilities against surface and air targets. High density nano metals compounded with hydrocarbon and fluorinated polymers using reproducible production techniques were demonstrated and evaluated.
FY05 – Conduct research, development, and testing of high density reactive material compositions (densities greater than 5 gram/cubic centimeters) to determine effectiveness against various surface and air targets.

	FY 2004	FY 2005
ADVANCED SMART OPTICAL SENSOR PAYLOAD TECHNOLOGY FOR SURVEILLANCE	0	990

Effort supports Advanced Smart Optical Sensor Payload Technology for Surveillance.

	FY 2004	FY 2005
AIRCRAFT CARRIER SURVEILLANCE SYSTEM	0	2,774

Effort supports Aircraft Carrier Surveillance System.

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	FY 2004	FY 2005
CHEMICAL WEAPON DETECTION FOR UAV APPLICATIONS	1,349	0

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

	FY 2004	FY 2005
COMBUSTION LIGHT GAS GUN	4,090	4,160

This effort involved the development of the technologies to develop a hyper-velocity weapon based on high-energy electric plasma ignition heating of injected light gas. FY04: Completed initial design of cryogenic handling and fill system and completed set up and test fire of 45mm gun test bed. FY05: Design and engineer a 155mm CLGG system capable of demonstrating full scale, single shot performance. Demonstrate operational characteristics using cryogenic propellants.

	FY 2004	FY 2005
DEVICE INTEGRATION OF WBG SEMICONDUCTORS AND CRYSTALINE OXIDES	1,345	1,684

FY04: This effort developed techniques and instrumentation to improve passive oxide components for tunable power microwave amplifiers for application to the Advanced Multifunction Radio Frequency System. FY05: The deposition system for oxide component deposition will be commissioned and growth parameter variables quantified. Test structures will be grown for initial calibration and feedback for optimization of deposition parameters.

	FY 2004	FY 2005
ELECTROMAGNETIC (EM) RAIL GUN TEST MUNITION	0	1,090

Effort supports Electromagnetic (EM) Rail Gun Test Munition.

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	FY 2004	FY 2005
FIRELIDAR	1,445	1,684

FY04: This effort developed an eyesafe laser imaging system complementary to IR imagers. Firelidar used a 1.5 micron laser and a highly transmissive narrow band filter to minimize blooming from fire sources, to see through smoke, water, and glass. FY05: Effort will focus on innovative technologies to overcome the deficiencies of an infrared sensors used by firefighters. These sensors currently bloom and become useless in brightness of a hot fire. The approach will use laser illumination and spectral filters to see through fire and smoke. Imagery will also be relayed via a wireless LAN to the command center.

	FY 2004	FY 2005
FREE ELECTRON LASER	6,728	0

This effort developed technologies to support the development of a high average power Free Electron Laser system that is applicable to shipboard self defense.

	FY 2004	FY 2005
GALLIUM NITRIDE (GAN) MICROELECTRONICS AND MATERIALS DEVELOPMENT	2,884	0

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

	FY 2004	FY 2005
HIGH EFFICIENCY PIEZOELECTRIC CRYSTALS	2,024	0

This effort developed defect-free lead magnesium niobate-lead titanate (PMN-PT) piezoelectric crystal material for significant (2-10) cost and performance improvement in Navy sonar and hydrophones, laser-acoustic modulators, focal plane micro-dither, and electronic beam steering applications.

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	FY 2004	FY 2005
HYBRID LIDAR-RADAR FOR IMPROVED OPTICAL IMAGING	1,639	0

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

	FY 2004	FY 2005
HYPERSONIC WEAPONS ENABLING CAPABILITY	0	990

This effort will develop Hypersonic weapon integration technologies.

	FY 2004	FY 2005
INTEGRATED BIOLOGICAL WARFARE TECHNOLOGY PLATFORM	4,962	3,467

FY04: This effort applied the integrated Biological and Chemical Warfare Defense (IBCWD) decision analysis technology software to survey vessels approaching aircraft carriers on the high seas. FY05: The program will transform the IBCWD software framework into a system that provides situation awareness, real-time response planning, and integrated collaborative center for decision maker interaction.

	FY 2004	FY 2005
INTEGRATED HIGH PAYOFF ROCKET PROPULSION TECHNOLOGY PROGRAM (IHPRPT)	988	0

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

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	FY 2004	FY 2005
INTEGRATED PERSONNEL PROTECTION SYSTEM	0	1,188

Effort supports Integrated Personnel Protection System.

	FY 2004	FY 2005
INTELLIGENT CONTROL SYSTEMS FOR SWARM UNMANNED AERIAL VEHICLES	4,096	0

This effort developed the algorithms and intelligent control technologies to enable the employment of multiple UAV's for the completion of a variety of operational missions.

	FY 2004	FY 2005
INTERROGATOR FOR HIGH-SPEED RETRO-REFLECTOR COVERT COMMUNICATIONS	1,928	1,981

FY04: This effort increased retro reflector data rate to 10-50 Megabits per second. Developed Cats-eye lens for wide intercept angle to minimize laser interrogator pointing accuracy. FY05: This effort will develop and deliver a micro electronic mechanical system (MEMS) optical mirror, steered laser interrogator on a small tactical UAV and interrogate a 50 Mbps retro-reflector on an unattended ground sensor.

	FY 2004	FY 2005
KILL ASSIST ADVERSE-WEATHER TARGETING SYSTEM (KAATS)	3,059	1,684

This developed technologies to support a system that will provide precision targeting and weapon delivery in adverse weather for time critical missions. FY04: The Relative Guidance Data Link was designed, fabricated, integrated into the Joint Direct Attack Munitions (JDAM) weapon. FY05: Integrate and test sensor platform UAV. Demonstrate sensor on a UAV with relative targeting against a fixed target.

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	FY 2004	FY 2005
MILLIMETER/TERAHERTZ IMAGING ARRAYS	0	2,081

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

	FY 2004	FY 2005
MOBILE ON-SCENE SENSOR AIRCRAFT C4I CENTER	0	990

This effort will develop a mobile forward C4I deployed center that can receive imagery from an airborne sensor and executing command and control over that sensor.

	FY 2004	FY 2005
NON-LINEAR DYNAMICS - CONTROL OF CHAOS	3,278	0

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

	FY 2004	FY 2005
RADAR INFRARED IMAGING	2,017	0

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

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	FY 2004	FY 2005
SILVER FOX UNMANNED AERIAL VEHICLE (UAV)	0	2,476

This effort is to integrate the latest sensor and data link technologies into the Silver Fox UAV. The work will also expand the operational use of Silver Fox into the maritime environment.

	FY 2004	FY 2005
THERMAL MANAGEMENT SYSTEMS FOR HIGH DENSITY ELECTRONICS	5,059	5,943

FY04: This effort evaluated and demonstrated advanced cooling techniques for military processing systems. It included the cooling of a classified telecommunications processing system which has Special Operations Forces (SOF) deployment requirements. It also ruggedized high capacity imagery and data fusion processing airborne hardware. FY05: The work will utilize the advanced cooling techniques that have been developed and refine the techniques to work within the space, weight, and durability requirements of mobile electronics.

	FY 2004	FY 2005
ULTRA SHORT PULSE LASER TECHNOLOGY	1,349	0

This effort established a micromachining testbed to assist the transfer of ultra-short pulse laser machining technology. Developed precise micro-machining with negligible heat affected zones, improved holes in turbine blades, fuel injectors and airframes, semiconductor machining on Infrared focal plan arrays, etc.

	FY 2004	FY 2005
UNATTENDED IMAGING SENSOR NETWORK (UISN)	0	990

Effort supports Unattended Imaging Sensor Network (UISN).

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)

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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.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N
PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
FORCE PROTECTION APPLIED RESEARCH	104,801	143,652	101,650	130,227	151,143	141,482	125,350	103,731

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

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

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N
PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	112,868	96,269	98,643	125,631
Cong Rescissions/Adjustments/Undist. Reductions	0	-1,387	0	0
Congressional Action	0	48,800	0	0
Execution Adjustments	-7,142	0	0	0
FNC Realignment	0	0	3,150	5,906
Non-Pay Inflation Adjustments	-105	0	0	0
Program Adjustments	0	-30	-157	-2,087
Rate Adjustments	0	0	14	777
SBIR Assessment	-820	0	0	0
FY 2006/2007 President's Budget Submission	104,801	143,652	101,650	130,227

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2a

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602123N PROGRAM ELEMENT TITLE: FORCE PROTECTION APPLIED RESEARCH
PROJECT TITLE: FORCE PROTECTION APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
FORCE PROTECTION APPLIED RESEARCH	104,801	143,652	101,650	130,227	151,143	141,482	125,350	103,731

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. 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 effort supports the Fleet/Force Protection, Missile Defense, and Advanced Capability Electric Systems (ACES) Future Naval Capabilities (FNC).

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
SURFACE SHIP & SUBMARINE HULL MECHANIC & ELECTRICAL (HM&E)	40,572	55,385	49,311	72,189

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 and maneuvering. 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.

BUDGET ACTIVITY: 02
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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 activity supports the Advanced Capability Electric Systems (ACES) Future Naval Capability (FNC). This activity includes support to the FNC Enabling Capabilities for Battlefield Power. Increased funding in FY 2005 will be used to advance technology in the areas of fast-high power switches, capacitors, power and thermal management, fuel cells, and advanced power generation. Additional funding added in FY 2007 will be invested in power and energy technology.

FY 2004 Accomplishments:

- Continued development of analytical models to further define submarine modular hull concepts.
- Continued investigation of potential applications of silicon-carbide in future high voltage and high power applications.
- Continued the next generation Infrared Electro-Optic Visual (IR/EO/VIS) model for surface ships by development of mitigation strategy supporting low observable infrared platforms, development of supporting physics, and prototype measurement techniques.
- Continued preparation for shock testing of composite hull section in cooperation with Germany.
- Continued feasibility study of distributed pump-jet propulsion system (DPJP) concept for submarines.
- Continued evaluation of an Integrated Engineering Plant (IEP) concept to provide improved survivability of auxiliary systems that support combat systems.
- Continued advanced numerical acoustic codes (and gridding methods for those codes) for submarines.
- Continued algorithm/finite element model validation for submarine advanced degaussing/deamping.
- Continued physics based numerical model for electromagnetic scattering of hydrodynamic disturbances for Surface Ships.
- Continued development of surface ship acoustic flow noise model. Performed tank test for surface ship acoustic behavior validation.
- Continued evaluation of prediction methods which relate ship hydrodynamics and ship signatures.
- Continued to develop design tool for integrated antenna and composite topside.
- Continued development of reliability based design and structural analysis code development.
- Continued to investigate improved maneuvering simulation capability for submarines.
- Continued analytical and modeling investigation of cavitation, powering, and acoustic performance of submarine propellers.
- Continued study of flow noise over submarine control surfaces.
- Continued investigation of hybrid composite to steel joints for hybrid surface ship hulls, contributing

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to agreement with Japan.
- Continued Dynamic Behavior of Composite Ship Structures (DYCOSS) joint effort with Dutch Navy.
- Continued designing software for the system manager for the Universal Control Architecture (UCA).
- Completed the validation of circulation control and advanced control surfaces with experiments.
- Completed comparison of DYSMAS analysis with German ship trial data.
- Completed development of a propeller sub-visual cavitation inception scaling law.
- Continued development of global surface wave measurement capability for ship models.
- Completed design and fabrication of Advanced Ducted Electric Propulsion Pod (ADEPP) model for hydrodynamic performance testing in the Large Cavitation Channel (LCC).
- Completed documentation of the historical use of circulation control technology in the Navy.
- Completed fabrication of prototype acoustic wireless sensor array for submarines.
- Completed validation of advanced prediction code for large amplitude roll motion of surface ship hulls.
- Completed, validated, and applied numerical codes to integrated propulsor/hull for advanced surface ship configurations.
- Initiated preliminary testing of Explosion Resistant Coating (ERC) against underwater explosion and ballistic threats.
- Developed technology for two-sided, low loss, high voltage power switches. (NRL)
- Initiated modeling of electric warship components and system electromagnetic signatures.
- Initiated investigation of superconducting degaussing techniques for surface ships.
- Initiated development of modeling and simulation tools for submarine coating concept.
- Initiated mmWave Signatures Analysis.
- Initiated circulation control analysis for three-dimensional flow effects.
- The following efforts reflect Electric Ship Research and Development Consortium (ESRDC) investments:
  - Completed fabrication of Fast Turn Off Phase Leg.
  - Initiated 9MVA Power Electric Building Block (PEBB) developmental demonstrations.
  - Initiated decentralized thermal management modeling and simulation.
  - Initiated demonstration of dynamic reconfigurable electric power control architecture.

FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed above.
- Continue and accelerate ship service fuel cell development.
- Continue and accelerate development of thermal management technology for shipboard power distribution.
- Continue Characterization of Biofilms on Scaffolds. (NRL)

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- Complete circulation control analysis for three-dimensional flow effects.
- Complete development of modeling and simulation tools for submarine coating concept.
- Complete numerical model for electromagnetic scattering.
- Complete 9MVA PEBB developmental demonstrations.
- Complete thermal management modeling and simulation.
- Complete and deliver next generation IR scene model and next generation IR code.
- Complete demonstration of Fast Turn Off Phase Leg.
- Complete demonstration of dynamic reconfigurable electric power control architecture.
- Complete evaluation of prediction methods which relate ship hydrodynamics and ship signatures.
- Initiate and complete demonstration of prototype acoustic wireless sensor array system incorporating self powering, radio frequency unit, and sensors.
- Initiate and complete circulation control analysis for three-dimensional flow effects.
- Initiate and complete validation of Reynolds Average Navier-Stokes (RANS) code for advanced waterjet propulsor performance predictions.
- Initiate and complete validation of asymmetric hull forms with experimental data.
- Initiate development of a low-cost submarine distributed propulsor concept.
- Initiate development of flexible composite propeller concept.
- Initiate validation of powering prediction method for distributed pump-jet propulsion (DPJP) concepts.
- Develop Bacterial Mixture to Optimize Charge Generating Capacity. (NRL)
- Initiate development of quiet control surface design tool based on control surface flow noise studies.
- Fabricate High Surface Area Conducting Electrodes for use as Biofilm Scaffolds. (NRL)
- Form Biofilms on Scaffolds and Characterize Spatial Distribution and Chemistries. (NRL)
- Initiate development of structural analysis codes describing failure mechanisms of sandwich composites.
- Initiate work to assess cavitation performance of loop-bladed propulsor concept.
- Initiate development of test vessel and technology to evaluate performance and signature associated with electrically driven waterjets (AWJ-21) and Rim-drive motor (Advanced Hull-form Inshore Demonstrator - AHFID).
- Initiate multi-year program to directly convert thermal energy to electricity. Such a capability would allow elimination of the steam cycle on an electric warship.
- Initiate and accelerate development of pulsed power technology, to include pulsed alternators and capacitors.
- Initiate ACES applied research for on-board vehicle power system with trade studies and system design (transition to advanced technology effort in PE0603123N in FY 2006).
- Initiate flow noise evaluations of surface ships with AWJ-21 demonstrator.
- Initiate hull machinery noise measurements.

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- Initiate Advanced Concept Technology Demonstration (ACTD) support for ERC application to surface ships.
- Pursue technology for wafer bonded high voltage power switches. (NRL)
- Pursue technology for alternate approaches to high voltage fast turn off switches. (NRL)

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete flow noise evaluations of surface ships with AWJ-21 demonstrator.
- Complete shock testing of composite hull section in cooperation with Germany.
- Complete dynamic reconfigurable electric power distribution concepts.
- Complete development of flexible composite propeller concept.
- Complete investigation of distributed pump-jet propulsion acoustic performance.
- Complete the initial assessment of performance and maneuvering of asymmetric hull forms.
- Complete validation of powering prediction method for distributed pump-jet propulsion (DPJP) concepts.
- Initiate prediction of constrained (heave and roll) capsize motions using advanced codes.
- Initiate and complete demonstration of dynamic stability of an advanced intelligent, reconfigurable, solid-state-based, zonal-electrical power system that reconfigures within 10 milliseconds.
- Develop and fabricate mm to um-scale Biofilm Scaffolds. (NRL)
- Develop Inch-Scale Prototype Microbial Fuel Cell to Test Scaffolds/Electrodes. (NRL)
- Initiate demonstration of “point of use” electric power system architectures and advanced energy storage.
- Initiate definition of primary family of Power Electronic Building Blocks for DoD Power applications and Plug and Play criteria for military electric power systems.
- Initiate Power Characterization on Prototype. (NRL)
- Pursue technology for characterizing defects in silicon carbide materials. (NRL)
- Pursue technology for highly efficient high voltage high power switches. (NRL)

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Complete evaluation of an Integrated Engineering Plant (IEP) concept to provide improved survivability.
- Complete hull machinery noise measurements.
- Complete Dynamic Behavior of Composite Ship Structures (DYCOSS) joint effort with Dutch Navy.
- Complete modeling of electric warship components and system electromagnetic signatures.

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- Complete investigation of distributed pump-jet propulsion acoustic performance.
- Complete ACTD support for ERC application to surface ships.
- Complete development of global surface wave measurement capability for ship models.
- Initiate and complete experimental database for extreme submarine maneuvers (e.g., crashback).
- Initiate development of mitigation concepts (passive and active) of propulsor cavitation.
- Initiate fabrication of small-scale composite hull structure for acoustic investigation.
- Initiate demonstration of distributed power generation, rapid power transfer, and energy storage technologies within the context of zonal electric power systems.
- Initiate ACES development of backpack-sized power generation technologies to provide a primary charging system of approximately 500 Watts.
- Miniaturize Prototype Biofilm-Enhanced Power Generator. (NRL)
- Characterize and Optimize Miniaturized Prototype Power Output. (NRL)
- Expand the study of reliability of silicon carbide power switches. (NRL)
- Pursue new concepts for high power high voltage switches. (NRL)

	FY 2004	FY 2005	FY 2006	FY 2007
ADVANCED ENERGETICS	0	12,293	14,963	15,952

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

FY 2004 Accomplishments:

- Continued development and evaluation of advanced explosive/propellant/reactive ingredients and formulations for next generation higher performing systems until expenditure of FY 2003 funding.
- Continued development of advanced directed energy hydro-reactive material warhead concepts to enhance performance of undersea warheads until expenditure of FY 2003 funding.
- Continued technology development for the next generation reactive material warhead concepts (formulations,

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material properties, and lethality models) for high density reactive materials and novel reactive structural materials.

FY 2005 Plans:

- Continue all efforts of FY 2004.
- Initiate efforts to investigate advanced multiphase blast concepts to enhance performance of air and underwater blast warheads.
- Initiate proof of concept efforts to develop insensitive explosives, propellants, and munitions without compromising performance. This work will involve development of high quality, small particle energetic ingredients, novel processing techniques, and advanced energy conversion concepts.

FY 2006 Plans:

- Continue all efforts of FY 2005.

FY 2007 Plans:

- Continue all efforts of FY 2006.

	FY 2004	FY 2005	FY 2006	FY 2007
FLEET FORCE PROTECTION AND DEFENSE AGAINST UNDERSEA THREATS	13,836	10,398	18,090	19,835

This Activity is combined and renamed from Sensors and Associated Processing Activity and Underwater Platform Self-Defense Activity to more accurately describe its scope.

Fleet Force Protection and Defense against Undersea Threats efforts include applied research for complementary sensor and processing technologies for platform protection and shipboard technologies to increase the survivability of surface ship and submarine platforms against torpedo threats. Current small platforms (both surface and airborne) have little to no situational awareness (SA) or self-protection against air, surface, and asymmetric threats. A goal of this activity is to provide these platforms with effective self-protection. The technology areas specific to platform protection will develop individual, multispectral (Electro-Optic (EO), Infrared (IR), Radio Frequency (RF), electromagnetic (EM), visual, and acoustic), or chemical

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sensors/biosensors 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.

Another goal of this effort is to develop a torpedo defense capability to fill Sea Shield Warfighting Capability Gap/Enabling Capability: Platform Defense against Undersea Threats, including Two Torpedo Salvo Defense. This provides a capability to prevent any of the torpedoes, in up to four-torpedo salvos fired at high value units, from hitting those units. Specific technology includes two efforts. The first is 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 second is 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 activity supports the Fleet and Force Protection Future Naval Capabilities (FNC). This effort includes support to Sea Shield Pillar and FNC Enabling Capabilities for Aircraft Integrated Self-protection Suite, Fortified Position Security, and Hostile Fire Detection and Response Spirals 1 and 2. Budget Activity 2 sensor efforts are co-funded by PE 0602235N and 0602271N. Funding decrease in FY 2005 reflects transfer of sensor effort to PEs 0602235N and 0602271N.

FY 2004 Accomplishments:

Sensors & Associated Processing -
- Continued development of reagentless sensors for weapons of mass destruction/explosives.
- Continued field tests to assess system performance and quantify influences on detection range with respect to signal detection and jamming of threats to low altitude platforms. (NRL)
- Completed development of mercury cadmium telluride (MCT) mid-wave infrared (MWIR) two-color stacked diode focal plane arrays with operating temperatures in excess of 120-degrees Kelvin for Missile Warning System.
- Completed development of a high frame rate processor and controller for the Visible and MWIR laser receiver sub-systems of the closed-loop countermeasure system for the Shipboard EO/IR Closed Loop Self-protection system.
- Completed optimization experiments of the multiband countermeasure laser showing output power exceeding expected values in Bands II and IVb for EO/IR Laser Jammer for Tactical Aircraft (TACAIR).
- Completed delivery of two Dismounted Digital Automated Computing Terminal (D-DACT) units to Kodak for

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integration with Organic Light Emitting Diode (OLED) displays for End User Terminal (EUT).
• Completed fabrication of a silica-insulated microwire with adequate breakdown voltage and temperature characteristics in continuous lengths exceeding 600 meters that also exceeds the program's mechanical strength requirements for IDECM P3I.
• Completed efforts in stochastic chemical sensors for naval applications to provide single molecule detection.
• Completed the design for user interface for low-cost compact adaptive optics system. (NRL)
• Developed extremely high extraction efficiencies for explosives on a microchip-based sensor by means of novel porous organic sol-gels polymerized within microfluidic channels. (NRL)
• Initiated development of anti-tampering antenna isolation panels for NULKA decoys: lightweight microwave absorbing composites that degrade in seawater. (NRL)
• Initiated development of a small aperture biomimetic bidirectional acoustic sensor and quantum dot reagents for real time chemical sensing.

Underwater Platform Self-Defense –
• Completed transducer design for NGCM mobile-ready transducer.
• Completed transition of technologies for enabling ATT salvo engagements into the Technology Requirements Model (TRM) engagement model to allow evaluation of these approaches to salvo engagements.
• Completed upgrade of simulation models using the TRM framework to enable simulation of the performance of the ATT with added ATT sonar processing channels in wake operations.
• Initiated mobile NGCM guidance and control interface to Naval Underwater Weapon Center (NUWC) Newport Division signal generation electronics.
• Initiated NGCM testbed power amplifier design and started design for merging adaptive and signal processing board into single board for NGCM/MK2.

FY 2005 Plans:

Sensors & Associated Processing –
• Continue all efforts of FY 2004 less those noted as completed above.
• Continue work on anti-tampering antenna isolation panels for NULKA decoys: fabricate hydrogen-bonded polymers and test for sensitivity to water degradation. Test isolation performance of new microwave absorbing composites. (NRL)
• Continue development of compact sensor systems in support of responsive Intelligence, Surveillance, and Reconnaissance (ISR). (NRL)

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- Complete the integration of all functions (detection, identification, and jamming) into a field testable Low Altitude Threat Detection and Jamming prototype and perform final concept test. (NRL)
- Complete development of a variable geometry mirror for the aircraft in conjunction with the ground based laser optics. (NRL)
- Complete the field tests to assess system performance and quantify influences on detection range with respect to signal detection and jamming of threats to low altitude platforms. (NRL)
- Antibodies for biowarfare agents will be synthetically modified with enzymes and studied via surface plasmon resonance to gain a better understanding of the impact tagging these recognition sites have on molecular recognition (kinetics and selectivity) for sensor applications. (NRL)
- Synthesize new metal sulfides as catalysts for fuel cells and evaluate their electrochemical performance. (NRL)
- Initiate design and development of large (1.5m dia.) telescopes with associated adaptive optics for the Naval Prototype Optical Interferometer (NPOI). (NRL)
- Initiate the design and development of integrated laser ground based, aircraft protection design to protect large aircraft from Infrared Surface to Air Missiles (SAMs) upon ingress and egress to an airport. (NRL)
- Initiate development of solid projectile coilgun design, consumable casing material and improve railgun efficiency. (NRL)

Underwater Platform Self-Defense –
- Continue all efforts of FY 2004 less those noted as completed above.
- Complete upgrade of TRM simulations with extended ATT guidance law for wake operations and integration of processing for all sonar channels.
- Initiate analysis of capability to enable limited acoustic communications among NGCM units.
- Initiate incorporation of ATT warhead acoustic model into TRM.
- Initiate modification of TRM simulations to include additional ATT salvo guidance techniques.
- Initiate technology development to enable NGCM group behavior.

FY 2006 Plans:

Sensors & Associated Processing -
- Continue all efforts of FY 2005 less those noted as completed above.
- Complete small aperture biomimetic bidirectional acoustic sensor efforts.
- Initiate platform integration analysis and design review for Integrated EO/IR Self-protection Suite for

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Rotary Wing Aircraft.
• Initiate testing of the MWIR gunfire detection system with the D-DACT network for End User Terminal (EUT).
• Initiate investigation of improved jam codes and closed-loop countermeasure techniques to integrate with the Shipboard Integrated Electro-Optic Defense Systems (SHIELDS) hardware for Shipboard EO/IR Closed Loop Self-protection.
• Initiate efforts in nanoscale biosensor/bioprocessing components.
• Initiate data collection for a database of chemical signatures from actual naval assets (land and water-based).
• Develop portable detection system for defense against small arms fire and rocket propelled grenades (RPG) using Field Programmable Gate Arrays (FPGAs), infrared focal plane arrays (IRFPA), and filtering algorithms. (NRL)
• Microfluidic electrophoretic separations will be performed on enzyme bound antibodies in the presence of antigens, taking advantage of post-column enzymatic amplification to monitor their interactions. (NRL)
• Enhance the sulfur tolerance of sulfide and phosphate based catalysts through optimization of synthesis and rigorous physical characterization. (NRL)
• Integrate and conduct prototype testing of the airborne mirror system and remote laser optics into a ground based test facility and evaluate their performance. (NRL)
• Expand research in the development of low-cost, light-weight radar absorbing materials (RAM) to reduce cost and weight of Tactical Unmanned Air Vehicles (UAV). (NRL)
• Continue the design and development of integrated laser ground based, aircraft protection design with final design of a rotating variable geometry mirror. (NRL)
• Continue railgun high-capacity recharger design, solid-projectile coilgun experiments, and consumable material characterization. (NRL)
• Complete development of anti-tampering antenna isolation panels for NULKA decoys: demonstrate isolation performance and water degradability of microwave absorptive composite. (NRL)

Underwater Platform Self-Defense –
• Continue all efforts of FY 2005 less those noted as completed above.

FY 2007 Plans:

Sensors & Associated Processing –
• Continue all efforts of FY 2006 less those noted as completed above.

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- Initiate laboratory investigations of the conformal jammer with fiber coupled laser concept for Integrated EO/IR Self-protection Suite for Rotary Wing Aircraft.
- Initiate development of additional jam codes and tracking algorithms to support final at-sea testing of the SHIELDs hardware for Shipboard EO/IR Closed Loop Self-protection.
- Complete development of quantum dot reagents for real time chemical sensing.
- Complete design and optimization of reagentless sensors for weapons of mass destruction and explosives.
- Conduct first demonstration of high resolution imaging of faint sources using the combined adaptive optics and optical interferometry at NPOI. (NRL)
- Demonstrate the efficacy of the NRL catalysts in fuel cells and work with industry to independently evaluate the catalysts. (NRL)
- Expand the integration effort into a mobile design and analyze the performance. (NRL)
- Microparticles will be labeled with selective antibodies and contained within novel microfluidic weirs devices, and studied for the simultaneous separation of multiple antigens in a single step. (NRL)
- Continue design and development of integrated laser ground based, aircraft protection with fabrication and initial integration with ground based system. (NRL)
- Continue high-capacity recharger experiments, coilgun armature experiments, and foreign object debris (FOD)-less casing fabrication. (NRL)

Underwater Platform Self-Defense –
- Continue all efforts of FY 2006.

	FY 2004	FY 2005	FY 2006	FY 2007
AIRCRAFT TECHNOLOGY	5,646	9,938	13,054	14,221

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

FY 2004 Accomplishments:

- Continued development of survivability/reduced observables technology (classified).

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- Continued Computational Fluid Dynamics (CFD) modeling of ship airwake flows to provide higher fidelity.
- Continued design for demonstration of an all-composite replacement for dynamically loaded control surfaces for tactical aircraft.
- Completed demonstration of intelligent flight control prognostics and reconfiguration algorithm simulations.
- Completed investigation of in-flight, autonomously reconfigurable air vehicles.
- Initiated Persistent Intelligence, Surveillance, and Reconnaissance (ISR) Unmanned Air Vehicle (UAV) technologies: Capability tailored to the Expeditionary Strike Group (ESG), a high endurance sensor and communication capability focused on disparate structurally integrated sensors (Electro-Optic (EO), Infrared (IR), Radio Frequency (RF)), electronic support, and communications packages, low volume high power generation capability, high capacity miniaturized data transmission, and short take off.
- Initiated Joint Transformational Strike (JTS) technology addressing Automatic Target Recognition (ATR) and Combat Identification (CID).

FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed above.
- Complete Computational Fluid Dynamics (CFD) modeling of ship airwake flows to provide higher fidelity.
- Complete design for demonstration of an all-composite replacement for dynamically loaded control surfaces for tactical aircraft.
- Complete Persistent Intelligence, Surveillance, and Reconnaissance (ISR) Unmanned Air Vehicle (UAV) technologies effort.
- Complete Joint Transformational Strike (JTS) technology addressing Automatic Target Recognition (ATR) and Combat Identification (CID).

FY 2006 Plans:

- Continue development of survivability/reduced observables technology (classified).
- Initiate demonstration of system integration of a shaped memory alloy into a Reconfigurable Rotor Blade system for improved range and lifting capacity in a tilt rotor aircraft.
- Initiate development of Ship-To-Objective Maneuver (STOM) Heavy Lift System Concept.
- Initiate development of flight control, intelligent autonomy, command & control, and multi-vehicle cooperation technologies for unmanned air vehicles.

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FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.

	FY 2004	FY 2005	FY 2006	FY 2007
MISSILE DEFENSE (MD)	7,753	7,305	6,232	8,030

This activity describes science and technology (S&T) projects of the Missile Defense Future Naval Capability (FNC) program:
- Distributed Weapons Coordination (DWC) (including sensor coordination) open architecture combat system algorithms for automated battle management aids (ABMA), including common threat evaluation (CTE) and preferred shooter recommendation (PSR) functions that will enable fleet units to defend against air and missile attacks with increased effectiveness and efficiency.
- Littoral Affordability (classified program).
- Advanced Area Defense Interceptor (AADI) S&T planning effort for Navy - Marine Corps Air Directed Surface to Air Missile (ADSAM) live firing demonstration at White Sands Missile Range in FY08.
- Composite Combat Identification (CCID) algorithms for rapid, high confidence, positive hostile identification of air and missile threats at long range by all theater air and missile defense units.

FY 2004 Accomplishments:

- Continued development of DWC algorithms for CTE and PSR functions; initiated development of sensor coordination algorithms.
- Continued Littoral Affordability effort (classified program).
- Completed CCID risk reduction effort in development of a common reasoning algorithm. Overall CCID effort continuing under PEs 0602235N and 0603235N.

FY 2005 Plans:

- Continue DWC and Littoral Affordability efforts of FY 2004.
- Initiate AADI experimental planning for Navy ADSAM demonstration in FY 2008 (associated with AADI advanced technology efforts continuing under PE 0603123N).

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FY 2006 Plans:

- Continue all efforts of FY 2005.

FY 2007 Plans:

- Continue AADI S&T planning and coordination for FY 2008 Navy ADSAM live-fire demonstration.
- Complete DWC development and documentation of CTE and PSR algorithms; continue development and testing of sensor coordination algorithms.

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
ADPICAS	0	1,485

FY 2005: Initiate development of intelligent composite active structures and systems to provide precision position control and vibration suppression for military and space structures to enhance their structural performance and reduce their fuel consumption. Applications include fighter jets, helicopters, smart rockets, satellites, and space stations.

	FY 2004	FY 2005
BATTERY CHARGING TECHNOLOGY	2,051	2,081

FY 2004: Completed a prototype battery charger for nickel cadmium and sealed lead acid batteries and delivered the unit to NAVSEA-Crane for 3rd party performance verification. Prototype testing demonstrated that the batteries tested under this tasking can be charged without heating in 20 to 30 minutes, and life cycle testing has begun. FY 2005: Continue research efforts funded in FY 2003 and FY2004. Initiate development and validation of a charging algorithm for lithium-ion batteries. Initiate development of a DC-DC converter hardware design and engineering model.

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	FY 2004	FY 2005
BLAST RESISTANT ANECHOIC SPRAYABLE ELASTOMERIC COATINGS FOR NAVY SHIPS	0	990

FY 2005: Initiate development, testing, and evaluation of a new coating system that can be applied to metal ship bulkheads and armored vehicles providing blast protection to the occupants. The end of the first year of development will result in one or more fire retardant coating systems that can be applied to metal structures and provide blast protection.

	FY 2004	FY 2005
CENTER FOR ADVANCED POWER SYSTEMS	3,854	0

FY 2004: Completed purchase of state-of-the-art energy storage devices, DC experimental bus including controls and system integration, and completed 5MW superconducting motor testing.

	FY 2004	FY 2005
CENTER FOR CRITICAL INFRASTUCTURE PROTECTION	0	6,735

FY 2005: Initiate development of innovative technology solutions for use in the protection of critical infrastructure. Technologies will be developed that will increase protection for ports and the merchant shipping system, maintaining port operations, and the surrounding infrastructure.

	FY 2004	FY 2005
COMPOSITE REPAIR OF METAL STRUCTURES	0	990

FY 2005: Initiate development of low cost, sonic resistant composite repairs for metal airframe structures. This new concept for the repair of the Navy’s aging fleet of both fixed wing and rotary wing aircraft offers the promise to extend the airframe life at a significantly lower cost and with greater reliability and safety than methods currently in use.

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	FY 2004	FY 2005
COMPOSITES DEVELOPMENT FOR NAVY LOW RISE CONSTRUCTION	0	1,485

FY 2005: Initiate development and demonstration of prototype wood plastic composite (WPC) structural components for military housing. These structural components will provide the following advantages relative to conventional wood products; (1) resist moisture penetration into the building structure, (2) resist high lateral loads from seismic and wind events, and (3) facilitate proper construction techniques.

	FY 2004	FY 2005
CORROSION MODELING SOFTWARE PROJECT - NAVAIR	3,042	4,160

FY 2004: Completed development of a workable analytical corrosion maintenance model and validated through specimen testing, in an effort to establish guidelines and criteria for high strength steel components, in particular, arrestment gear of carrier aircraft. FY 2005: Continue development and validation testing of workable corrosion maintenance guidelines and criteria for high strength steel components. Airframe criteria calling for the repair and/or replacement of all corroded parts in the Fleet are very difficult to implement both with respect to time and resources. The results of this effort will enable maintenance teams to delineate between various aircraft corrosion states, with potential safety impacts and identification of corrosion that is cosmetic.

	FY 2004	FY 2005
DEPLOYABLE FIBER OPTIC FORCE PROTECTION SYSTEM	961	0

FY 2004: Initiated research and development for a smart video camera system and passive fiber optic hydrophone array and processor to provide security against a waterside terrorist threat approaching Navy ships. Coordinating effort with synergistic project at DSTO Australia.

	FY 2004	FY 2005
FUSION PROCESSOR AND INTEGRATED CONTEXTUAL REASONING	6,150	0

FY 2004: Completed process of Navy Hyperspectral/Imaging for Surveillance and Targeting (HISTAR) data using hyper-spectral target detection and discrimination algorithms in real-time to optimize performance, minimizing

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false alarms. System being installed on NRL P-3 test aircraft for performance assessment.

	FY 2004	FY 2005
HIGH EFFICIENCY QUIET ELECTRIC DRIVE	1,349	990

FY 2004: Completed development of a quiet, efficient, electric drive to allow transition from mechanical to electric drive in submarines and smaller surface combatants. Fabricated and tested a reduced-scale, single-phase demonstration model. FY 2005: Modify the single-phase model to a three-phase model and test and evaluate.

	FY 2004	FY 2005
HYPERSPECTRAL DATA FUSION	0	3,368

FY 2005: Initiate demonstration of a hyperspectral/imager for surveillance and tracking in the airborne realtime processing on the NRL P-3 test aircraft.

	FY 2004	FY 2005
INTEGRATED FUEL PROCESSOR–FUEL CELL SYSTEM	2,324	1,981

FY 2004: Completed design, fabrication & testing of a single, semi-integrated fuel-processing reactor utilizing a surrogate fuel. Continued development of hydrogen purification & thermal integration units and performed a reactor switching demonstration of the prototype hardware. FY 2005: Develop and demonstrate a prototype integrated fuel processor/fuel cell system to operate on JP-5 fuel. If successful, the system may provide payoffs of increased efficiency and lower emissions of auxiliary power units used onboard aircraft and ocean-going vessels.

	FY 2004	FY 2005
LIGHTWEIGHT SHIP STRUCTURES (LSS)	0	990

FY 2005: Initiate research to explore, develop and optimize alloys based on Al-Zn-Mg-Sc-Zr. Efforts will include alloy fabrication, microstructural and mechanical characterization, stress corrosion cracking studies and development of a cost-benefit analysis, demonstrating the feasibility of implementing the alloy and

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providing the foundation for subsequent certification.

	FY 2004	FY 2005
LOW-COST, RAPID PROTOTYPE/PRODUCTION TECHNOLOGY FOR POLYMERIC AIRCRAFT COMPONENTS INITIATIVE	1,447	2,278

FY 2004: Initiated the development and qualification of a rapid prototyping and production technology based on Selective Laser Sintering (SLS) which will be used for the design, development and qualification of advanced polymeric aircraft components. The SLS process uses a laser to fuse (sinter) plastic powders into complex shaped plastic parts. A part can be built using only the computer aided design (CAD) model downloaded directly to the laser-sintering machine. This technology will help reduce the weight and manufacturing costs of aircraft components while improving their performance. FY 2005: Continue with the development and qualification of a rapid prototyping and production technology based on Selective Laser Sintering (SLS) which will be used for the design, development, and qualification of advanced polymeric aircraft components. The focus for this year's effort will be on material and process optimization with emphasis on meeting aerospace application requirements.

	FY 2004	FY 2005
MARK V PATROL BOAT REPLACEMENT CRAFT PROTOTYPE	0	1,485

FY 2005: Initiate construction of the new composite MKV.I prototype craft.

	FY 2004	FY 2005
MINIATURE AUTONOMOUS VEHICLES (MAVS)	1,163	1,784

FY 2004: Completed validation, through in-water testing, modeling, and simulation of a distributed communication and control architecture for a cooperating multi-vehicle fleet of autonomous underwater vehicles (AUV). FY 2005: Continue in-water demonstrations of distributed communications and control architecture. Expanded multi-vehicle fleet to include underwater crawlers.

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	FY 2004	FY 2005
NANOSTRUCTURED COMPOSITE MARINE COATINGS	2,409	0

FY 2004: Initiate development of multifunctional, high performance anticorrosion coatings that are capable of sequestering diffusive ions, are highly hydrophobic, and provide self healing properties using specific Ni catalysts and encapsulation techniques for ship tank application.

	FY 2004	FY 2005
PMRF FORCE PROTECTION LAB	0	7,924

FY 2005: Initiate development of force protection and security technologies by integrating, evaluating and demonstrating enabling technologies, tools, and processes. Approaches include integration of advanced sensor systems, novel sensor and data fusion processes, behavior modeling and analysis, and data mining and knowledge extraction techniques.

	FY 2004	FY 2005
PROJECT ENDEAVOR	3,296	1,684

FY 2004: Developed and integrated structural loading and hydrodynamic modeling design tools, and initiated transition of tools for Navy use at NSWC Carderock. FY 2005: Produce a software system that integrates the design process for advanced marine vehicles with mission and environmental (wind, wave, etc.) requirements, will begin to produce some stand-alone modules dealing with mission planning, wave forecasting and hindcasting as well as completing the integration process. A major focus will be technology transfer of system components.

	FY 2004	FY 2005
SMALL WATERCRAFT PROPULSION DEMONSTRATOR	0	1,485

FY 2005: Initiate development of an advanced internal combustion engine and associated electrical generator.

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	FY 2004	FY 2005
SOLID OXIDE REGENERATIVE FUEL CELL	2,900	0

FY 2004: Conducted thermal cycling and long-term reliability testing to demonstrate the durability and reliability of a 1 KW regenerative solid oxide fuel cell. Solid oxide fuel cells have the potential to offer improved fuel efficiencies and power densities over other options for naval vessel applications.

	FY 2004	FY 2005
STRUCTURAL RELIABILITY OF FRP COMPOSITE IN SHIP ASSEMBLIES	1,932	990

FY 2004: Completed fabrication of VARTM/SCRIMP composite panels. Material properties were evaluated for statistical data analysis and model development. FY 2005: Resolve the uncertainty surrounding mechanical property variability for composite laminates and the associated effect on structural reliability as it relates to design guidelines and analysis methods.

	FY 2004	FY 2005
THEATER SUPPORT VESSEL HULL MATERIAL DEVELOPMENT	0	1,981

FY 2005: Initiate the design and development of technologies including an alternative hull and air cushion for advanced littoral combat ships. These technologies will allow improved delivery of firepower and information, as well as, increased hydrodynamic, aerodynamic, stealth, and survivability traits.

	FY 2004	FY 2005
UNMANNED SEA SURFACE VEHICLES FOR MARITIME MISSIONS	4,116	3,467

FY 2004: Defined operational concept and completed design of prototype unmanned surface vehicles. Primarily focused on enhanced speed, range, endurance, seakeeping, and payload fraction, considered in the context of potential unmanned vehicle missions. Initiated construction of two prototypes for at-sea testing. Developed launch and recovery testbed. FY 2005: Deliver two prototype vehicles. Begin operational testing to determine at-sea performance. Develop techniques for deploying and retrieving vehicles from host platform. Incorporate advanced power and autonomy technologies.

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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)
PE 0603513N (Shipboard System Component Development)
PE 0603553N (Surface ASW)
PE 0603561N (Advanced Submarine System Development)
PE 0603573N (Advanced Surface Machinery Systems)
PE 0603609N (Conventional Munitions)
PE 0603640M (USMC Advanced Technology Demonstration (ATD))
PE 0604307N (Surface Combatant Combat System Engineering)
PE 0604518N (Combat Information Center Conversion)
PE 0604558N (New Design SSN)
PE 0604561N (SSN-21 Developments)

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

D. ACQUISITION STRATEGY:
Not applicable.

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PROGRAM ELEMENT: 0602131M
PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
MARINE CORPS LANDING FORCE TECHNOLOGY	29,541	37,036	37,590	37,516	39,136	39,986	41,125	42,059

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

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

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M
PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	32,375	35,398	38,707	38,022
Cong Rescissions/Adjustments/Undist. Reductions	0	-354	0	0
Congressional Action	0	2,000	0	0
Program Adjustments	0	-8	-1,614	-594
Execution Adjustments	-2,579	0	0	0
Non-Pay Inflation Adjustments	-30	0	0	0
Rate Adjustments	0	0	497	88
SBIR Assessment	-225	0	0	0
FY 2006/2007 President's Budget Submission	29,541	37,036	37,590	37,516

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
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COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
MARINE CORPS LANDING FORCE TECHNOLOGY	29,541	37,036	37,590	37,516	39,136	39,986	41,125	42,059

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project is organized into six activities which are represented as five Expeditionary Warfighting Capability Areas and the Littoral Combat/Power Projection (LC/PP) Future Naval Capability (FNC). The five Expeditionary Warfighting Areas support the Discovery and Inventions (D&I) and the Innovation and Transformation (I&T) investment. The LC/PP FNC supports the Exploitation and Deployment (E&D) investment. Within the Naval Transformation Roadmap, this investment will achieve key transformational capabilities required by Sea Shield as well as enable the Ship to Objective Maneuver (STOM) and Persistent Intelligence, Surveillance and Reconnaissance (ISR), key transformational capabilities within Sea Strike and the enhanced Sea-borne Positioning of Joint Assets within Sea Basing.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
LITTORAL COMBAT/POWER PROJECTION	13,757	16,874	22,062	21,464

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

Through 2005 the focus of the FNC efforts has been on satisfying technology gaps related to Power Projection and Littoral Combat. As the products of these efforts are transitioned to acquisition programs of record, the focus of the FNC within this PE in FY 2006 and beyond will be on technology related to Urban, Asymmetric, and Expeditionary Operations (UAEO). The UAEO Capability Gap is a science and technology developmental area that is of the highest importance to Marine Corps operations in Iraq and Afghanistan. The UAEO Capability Gap is one of 25 prioritized Capability Gaps (prioritized by OPNAV N-6/7 and the Marine Corps Combat Development Command) that are made up of Enabling Capabilities (ECs) and supporting products. The UAEO technology gap is being pursued as part of an overall effort that addresses the Sea Strike Capability Gap.

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FY 2004 Accomplishments:

- Continued development of advanced target acquisition technologies for achieving interoperability among US/Joint/Coalition close air support platforms.
- Continued development of advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability.
- Continued development of Expeditionary Fighting Vehicle (EFV) obstacle avoidance system.
- Continued design, development and integration of hostile fire detection and counter-fire system (GUNSLINGER) spiral 1.
- Continued development of expeditionary maneuver planning and decision-making tools for Marine ground forces. Tested the software and evaluated during training exercises.
- Continued development of secure mobile network/secure wireless LAN technologies, including advanced protocols, frequency conversion and power amplification.
- Continued development and integration of innovative relays Beyond-Line-of-Sight (BLOS) in the areas of wideband communications.
- Continued development and demonstrated the Over-the-Horizon/Beyond-Line-of-Sight/On-the-Move (OTH/BLOS/OTM) tactical data network system for use by maneuver forces. (FY 05 efforts funded by PE 0603236N)
- Continued development and integration of advanced Position Location Information (PLI) system with range instrumentation enhancements. (FY 05 efforts funded by PE 0603236N)
- Initiated efforts to enhance and refine an automated Radio Frequency (RF) emitter mapping tool for Radio Battalions. (FY 05 efforts funded by PE 0603640M)
- Initiated development of advanced sensing algorithms to derive maps of water depths, current speed and direction, terrain elevation, and sandbar and obstacle location using digital imagery from airborne Intelligence, Surveillance, and Reconnaissance (ISR) assets to support expeditionary maneuver planning.
- Initiated development of algorithms for use in discriminating between individual single channel RF emitters on the battlefield and determining their locations.
- Initiated design of extended range and improved lethality mortar munitions.
- Initiated development efforts for a network monitoring and management tools technology.
- Initiated development and integration of organic light emitting diode (OLED) display technology for use by Marine Corps units. (FY 05 efforts funded by PE 0603236N)

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FY 2005 Plans:

- Complete development of technologies to enhance lethality and extend range for mortar munitions.
- Continue development of algorithms for use in discriminating between individual single channel RF emitters on the battlefield and determining their locations.
- Continue development of algorithms to derive maps of water depths, current speed and direction, terrain elevation, and sandbar and obstacle location using digital imagery from airborne ISR assets.
- Continue development of advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability.
- Continue development and test target acquisition technologies for achieving interoperability among US/Joint/Coalition close air support platforms and commence transition to acquisition.
- Continue EFV obstacle avoidance subsystem design, integrate subsystems and prepare for demonstration.
- Continue hostile fire detection and counter-fire subsystem design (GUNSLINGER).
- Continue development and integration of network monitoring and management tools technology.
- Continue integration and demonstration of innovative relays (BLOS) in the areas of wideband communications and advanced modular systems.
- Continue integration and testing of secure mobile network/wireless LAN technologies, including advanced protocols, frequency conversion and power amplification. (FY 06 efforts funded by PE 0603640M)
- Continue development of expeditionary maneuver planning and decision-making tools for Marine ground forces.
- Initiate effort in Distributed Common Ground/Surface System (DCGS) to improve integrated forecasting and planning and battlefield information integration.
- Initiate effort in DCGS that involves the migration of tactical intelligence systems (sensor networks) to a net-ready architecture and the development of enterprise services that translates and distributes this data.
- Initiate investigation of ammunition packaging techniques to lower weight and have the packaging provide additional use on the battlefield.
- Initiate development of an architecture to network existing expeditionary fires systems to enable MAGTF/ Joint Fires (fires coordination). (Concurrent effort funded by PE 0602236N)
- Initiate development of land mine countermeasure insensitive munitions technology.
- Initiate development of integrated vehicle self-defense system to defeat incoming Rocket Propelled Grenades (RPGs).

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FY 2006 Plans:

- Complete development of algorithms and commence modifications of hardware and software for use in discriminating between individual single channel RF emitters on the battlefield and determining their locations.
- Complete development of algorithms to derive maps of water depths, current speed and direction, terrain elevation, and sandbar and obstacle location using digital imagery from airborne ISR assets and initiate integration testing with ISR platform.
- Complete development and transition EFV obstacle avoidance capability to acquisition.
- Continue effort in DCGS that involves the migration of tactical intelligence systems(sensor networks) to a net-ready architecture and the development of enterprise services that translate this data.
- Continue development of advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability.
- Continue investigation of ammunition packaging techniques to lower weight and have the packaging provide additional use on the battlefield.
- Continue development of architecture, information exchange, connectivity and interoperability of target hand-off and fire control and coordination systems. (Previous and concurrent efforts funded by PE 0603640M; FY 07 effort will be funded by PE 0603640M))
- Continue design and test of hostile fire detection and counter-fire system (GUNSLINGER).
- Continue transition of expeditionary maneuver planning and decision-making tools for Marine ground forces to Navy and Marine Corps acquisition.
- Continue development of integrated vehicle self-defense system technologies to defeat incoming RPGs.
- Continue development and fabrication of full scale demonstration systems for landmine countermeasure insensitive munitions technology.
- Continue development and integration of network monitoring and management tools technology and transition to acquisition.
- Continue integration and demonstration of innovative relays (BLOS) in the areas of wideband communications and advanced modular systems.
- Initiate development of tactical ISR data pattern recognition material.

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FY 2007 Plans:

- Complete modifications of hardware and software for use in discriminating between individual single channel RF emitters on the battlefield and determining their locations.
- Complete development and transition airborne ISR (tactical littoral sensing) capability to acquisition.
- Complete transition and transition support of expeditionary maneuver planning and decision-making tools for Marine ground forces to Navy and Marine Corps acquisition.
- Complete investigation of ammunition packaging techniques to lower weight and have the packaging provide additional use on the battlefield.
- Complete development and transition advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability to acquisition.
- Complete integration and testing of secure mobile network/secure wireless LAN technologies, including advanced protocols, frequency conversion and power amplification. (Previous effort funded by PE 0602236N and PE 0603236N)
- Continue development of tactical ISR data pattern recognition material.
- Continue development of architecture, information exchange, connectivity and interoperability of target hand-off and fire control systems.
- Continue development and fabrication of full scale demonstration systems for landmine countermeasure insensitive munitions technology.
- Continue design and test of hostile fire detection and counter-fire system (GUNSLINGER).
- Continue development of integrated vehicle self-defense system to defeat incoming RPGs.
- Continue development and integration of network monitoring and management tools technology and transition to acquisition.
- Continue integration and demonstration of innovative relays (BLOS) in the areas of wideband communications and advanced modular systems. Complete transition to the acquisition community.
- Initiate development of an integrated company level Urban Sensor Suite (Automated Control of Large Sensor Networks).

	FY 2004	FY 2005	FY 2006	FY 2007
MANEUVER	3,707	6,115	5,468	5,769

This activity supports and enhances the overall maneuver of forces ashore through the development of mobility, survivability, and unmanned ground vehicle technologies. The Maneuver Thrust Area focuses on the development,

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demonstration, and transition of technologies that will increase the warfighting capabilities and effectiveness of the Marine Corps Air Ground Task Force (MAGTF). This Thrust aims at capturing emerging and "leap ahead" technologies in the areas of mobility, materials, propulsion, survivability, durability, signature reduction, and modularity. A concentrated effort has been made in the development of modeling and simulation tools that integrate many different physics based modeling systems with rigorous operational analysis simulations to accurately define a system's performance characteristics. These tools will aid in defining the trade space for emerging technologies and assist in providing the Program Manager insight and guidance into pursuing future technologies. Beginning in FY 2006, this activity also develops technologies to enable land-mine detection, neutralization, breaching, and clearing from Beach Exit Zone to inland objectives. Therefore, efforts formerly reported under Mine Countermeasures (MCM) activity are now reflected under this activity. Mine Countermeasures (MCM) encompasses countermine, counter-Improvised Explosive Device (IED), and counter-Unexploded Ordnance (UXO) enabling technologies. Current Naval Mine Countermine (MCM) efforts address MCM capabilities through the Beach Exit Zone, but do not address a seamless, end-to-end MCM capability. MAGTF MCM must be a functional component of Naval Expeditionary Maneuver Warfare (EMW); to include Ship to Objective Maneuver, Expeditionary Operations from a Sea Base, Sustained Operations Ashore, and Operations Other Than War. In 2001 the Institute for Defense Analyses (IDA)/Office of Naval Research (ONR) "Mine Countermeasures (MCM) for Beach Exit Zone to Objectives Study" comprehensively looked at all on-going MCM programs and technologies, particularly U.S. Army MCM plans. The IDA/ONR MCM Study identified major MAGTF deficiencies (inadequately addressed in current Army, Navy, and Marine Corps programs). The IDA/ONR MCM Study's execution strategy was endorsed by senior Marine Corps leadership and is partially executed through this activity.

FY 2004 Accomplishments:

- Developed MAGTF Expeditionary Family of Fighting Vehicles (MEFFV) and Maneuver Technology Investment Strategies. Received MEFFV & Maneuver Technology Roadmaps.
- Completed Expeditionary Fighting Vehicle (EFV) band track redesign based on lessons learned and results from Phase I Assault Amphibian Vehicle (AAV) testing. Fabricated new tracks and tested on higher weight AAV.
- Completed Tactical Unmanned Ground Vehicle (TUGV) technology development and insertion into the Acquisition Program of Record improvements in propulsion, sensors, and data fusion capabilities. Conducted Mobility and Scout/Surveillance Demonstration at the Severe Off-road Track at Quantico.
- Continued lightweight Expeditionary Systems Materials (ESM) efforts to determine feasibility of scaling and producing candidate structural armor.
- Continued simulation based acquisition tool for conducting future combat vehicle design tradeoffs.

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FY 2005 Plans:

- Continue MEFFV technology development by initiating concept development and design using the simulation based design tool previously developed and results of subsystem developments.
- Continue Phase II ESM efforts and prepare for Phase III down selection process.
- Initiate Augmented Cognition efforts related ground vehicle applications.
- Initiate combat vehicle survivability study to develop armor solutions for application to current and future combat vehicles.
- Initiate Energetic Non-Explosive Reactive Armor (E NERA) technology development effort.
- Initiate USMC participation in Explosion Resistant Coatings (ERC) ACTD.

FY 2006 Plans:

- Complete USMC participation in Explosion Resistant Coatings (ERC) ACTD.
- Continue Phase III ESM efforts to determine feasibility of scaling and producing candidate structural armor and multifunctional materials.
- Continue modeling and simulation and analysis of alternative MEFFV concepts.
- Continue Augmented Cognition efforts related ground vehicle application.
- Continue Energetic Non-Explosive Reactive Armor development efforts.
- Initiate MAGTF Land MCM S&T initiatives to address detection and neutralization deficiencies within the MAGTF.

FY 2007 Plans:

- Continue Phase III ESM efforts including tests and demonstrations and prepare for transition of technology to the MEFFV program office.
- Continue Energetic Non-Explosive Reactive Armor development efforts.
- Continue MAGTF Land MCM S&T initiatives to address detection and neutralization deficiencies within the MAGTF.

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	FY 2004	FY 2005	FY 2006	FY 2007
HUMAN PERFORMANCE, TRAINING & EDUCATION (HPT&E)	2,344	3,350	1,784	1,993

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

FY 2004 Accomplishments:

- Completed development of a Proof of Concept Anti-Terrorism (AT) Tactical Decision Simulation (TDS) and performed a Cognitive Task Analysis (CTA).
- Completed development of a Logistics TDS.
- Continued development of technologies for Radio Frequency (RF) tracking and video tracking fusion for enhanced situational awareness in a Military Operations in Urban Terrain (MOUT) training environment.
- Continued development and evaluation of technologies for producing a common three dimensional (3D) database format and toolset suitable for use with rapid portable synthetic environment generation technology and tactical decision-making simulation technology.
- Initiated development of a Joint Terminal Attack Controller (JTAC) TDS including a CTA.
- Initiated evaluation of the suitability of cognitive performance enhancement (augmented cognition) technologies to improve human cognition via multiple sensory modalities.

FY 2005 Plans:

- Complete development of a JTAC TDS.
- Complete development of technologies supporting rapid and dynamic generation of 3D real-world terrain features suitable for Marine Corps training application.
- Complete the development of RF tracking and video tracking fusion for enhanced situational awareness in a MOUT training environment.
- Continue evaluation and development of tools to support real-time cognitive and behavioral assessment (augmented cognition) and improvement of individuals and teams during operations and training.
- Continue to research and develop tools to rapidly generate synthetic environments (3D databases, database correlation techniques) within and urban landscape (MOUT).
- Initiate development of realistic training environments that supplement field training and provide instructors with advanced situational awareness, after action review, and mission preview capabilities.

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- Initiate research to develop a comprehensive performance fidelity architectures for mapping training objectives, strategies and requirements onto training system specifications.
- Initiate research in the area of team training task analyses and training effectiveness evaluation techniques to develop more effective training systems for MOUT.

FY 2006 Plans:

- Continue evaluation and development of tools to support real-time cognitive and behavioral assessment (augmented cognition) and improvement of individuals and teams during operations and training.
- Continue developing a performance fidelity architecture, validating against existing USMC based training systems.
- Continue research in the area of team training task analyses and training effectiveness evaluation techniques to develop more effective training systems for MOUT.
- Continue to create validated realistic training environments that supplement field training and provide instructors with advanced situational awareness, after action review, and mission preview capabilities.
- Continue to research and develop tools to rapidly generate synthetic environments (3D databases, database correlation techniques) within and urban landscape (MOUT).
- Continue research to develop a comprehensive performance fidelity architectures for mapping training objectives, strategies and requirements onto training system specifications.
- Initiate research to develop metrics for improving an individual’s operational performance in stressful urban environments including use for selection and recruiting to that mission specialty.
- Initiate research to evaluate the feasibility of integrating augmented reality technologies into current and emerging training systems.

FY 2007 Plans:

- Complete development of a performance fidelity architecture, applying the model to develop guidelines and specifications for a to-be-built training system.
- Complete development of tools to rapidly generate synthetic environments (3D databases, database correlation techniques) within an urban landscape (MOUT), and apply to existing training programs (i.e., Virtual Technologies and Environments—VIRTE Demo III).
- Continue evaluation and development of tools to support real-time cognitive and behavioral assessment (augmented cognition) and improvement of individuals and teams during operations and training.
- Continue research in the area of team training task analyses and training effectiveness evaluation

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techniques to develop more effective training systems for MOUT.
- Continue to create validated realistic training environments that supplement field training and provide instructors with advanced situational awareness, after action review, and mission preview capabilities.
- Continue research to develop metrics for improving an individual's operational performance in stressful urban environments including use for selection and recruiting to that mission specialty.
- Continue research to evaluate the feasibility of integrating augmented reality technologies into current and emerging training systems.
- Initiate the development of training effectiveness measures and techniques as applied to disparate, multi-platform, multi-mission team training.

	FY 2004	FY 2005	FY 2006	FY 2007
COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE (C4ISR)	3,719	3,350	3,031	3,113

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

FY 2004 Accomplishments:

- Completed development of high-density, solid-state data storage devices.
- Continued development of conformal, broadband, Ultra High Frequency-Very high Frequency (UHF-VHF) antennas.
- Continued development of network mobility capabilities for the low-bandwidth, heterogeneous communication environment.
- Continued development of network security technologies for low-bandwidth wireless distributed environments.
- Initiated development of network management capabilities for the low-bandwidth, heterogeneous communication environment.
- Initiated development of low-probability of detection random noise communications waveforms.

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PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
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FY 2005 Plans:

- Complete development of network security technologies for low-bandwidth distributed environments.
- Continue development of FY2004 efforts less those noted as completed above.
- Initiate development of communications technologies for high attenuation and multi-path environments.
- Initiate development of technology to provide position location in global-positioning system restricted environments.

FY 2006 Plans:

- Complete development of conformal, broadband, UHF-VHF antennas.
- Continue development of FY 2005 efforts less those noted as completed above.
- Initiate development of information fusion technologies to allow automated construction of a common tactical picture from various sources of sensor data.
- Initiate development of low power consumption urban sensing technologies.

FY 2007 Plans:

- Complete development of low-probability of detection random noise communications waveforms.
- Complete development of communications technologies for high attenuation and multi-path environments.
- Complete development of technology to provide position location in global-positioning system restricted environments.
- Complete development of network management capabilities for the low-bandwidth, heterogeneous communication environment.
- Continue development of FY 2006 efforts less those noted as completed above.
- Initiate development of information management technologies to reduce information overload.
- Initiate development of processor-efficient measurements and signature intelligence information fusion algorithms.
- Initiate development of information management technologies to reduce information overload.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

	FY 2004	FY 2005	FY 2006	FY 2007
FIREPOWER	2,709	3,304	2,735	2,702

This activity develops technology for application on current and future expeditionary weapons and elements of the kill chain. It includes, but is not limited to, the following technologies: fuze, fire control, launch/propulsion, lethality, and accuracy.

FY 2004 Accomplishments:

- Completed Phase 2 of electromuscular disruption non-lethal weapon efforts. (Transitioned to PE 0603640M for FY05 advanced development)
- Completed investigation of in-service mortar barrel wear and materials and related processes to enhance the durability of future mortar systems.
- Completed an assessment of existing and evolving fuze technologies to enhance the reliability and safety of submunitions to be stored aboard U.S. Navy ships.
- Completed concept development effort for a mortar reconnaissance round to support warfighter situational awareness.
- Continued improved far target location and extended range performance and detection of camouflaged/hidden targets in support of M1A1 Firepower Enhancement Program. (Transitioned to PE 0603640M for FY05 advanced development)
- Initiated and completed development of concepts for the small arms sensor fusion to enhance the effectiveness of the individual warfighter in conjunction with the Joint Service Small Arms Program.

FY 2005 Plans:

- Initiate development of microelectromechanical systems (MEMS) concepts to comply with OSD submunition reliability and Navy Weapons Systems Explosive Safety Review Board requirements for submunitions to be stored aboard U.S. Navy ships. This includes development of a MEMS process micro detonator enabling technology.
- Initiate development of a concept for an insensitive munition (IM) propulsion system to enable firing a shoulder launched rocket from an enclosed space. Establish initial feasibility and practicality of solutions for improving firepower effectiveness.
- Initiate an assessment of current and emerging technologies to be incorporated into a Marine Advanced Combat Headborne System Initiative (MACHSI). The goal is to increase warfighter head and neck protection while

BUDGET ACTIVITY: 02
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enhancing warfighter comfort and minimizing warfighter encumbrance.

FY 2006 Plans:

- Complete MACHSI 6.2 effort and transition to 6.3 effort.
- Continue all efforts of FY05 less those noted as completed above.

FY 2007 Plans:

- Continue MEMS shipboard submunition fuze safety and reliability effort.
- Continue IM propulsion system above.
- Initiate assessment of current and emerging IM technologies for broad application to munitions for improving firepower effectiveness while increasing affordability and decreasing logistical burden in support of expeditionary warfare.
- Initiate an investigation of the scalability of variable yield conventional munitions technologies for improving firepower effectiveness while increasing affordability and decreasing logistical burden in support of expeditionary warfare.

	FY 2004	FY 2005	FY 2006	FY 2007
LOGISTICS	2,344	1,370	1,784	1,735

This activity supports Marine Corps Expeditionary Logistics which is the practical discipline and real world application of the deployment, sustainment, reconstitution, and re-deployment of forces engaged in expeditionary operations. Expeditionary Logistics replaces mass with assured knowledge and speed, is equally capable ashore or afloat in austere environments, and is fully scalable to meet uncertain requirements. Expeditionary Logistics logically divides into five pillars: deployment support, force closure, sustainment, reconstitution/redeployment, and command and control. These pillars are thoroughly integrated and perpetually related in execution.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
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FY 2004 Accomplishments:

- Completed initial exploration of the feasibility for lightweight expeditionary bridging capability through assessment of alternative bridging techniques, bridge design, and material solutions.
- Continued exploring the development of individual handheld water purification and desalination devices that can purify any source of water (fresh, brackish, and salt).
- Commenced research into the feasibility of using new polymer gel electrolytes and novel air electrodes in next generation metal air batteries.

FY 2005 Plans:

- Continue exploratory development of individual handheld water purification and desalinization devices to demonstrate the feasibility of performance improvement.
- Continue research into using polymer gel electrolytes and novel air electrodes in next generation metal air batteries to demonstrate the feasibility of performance improvement.

FY 2006 Plans:

- Complete exploratory development of individual handheld water purification and desalinization devices to demonstrate the feasibility of performance improvement.
- Continue research into using polymer gel electrolytes and novel air electrodes in next generation metal air batteries to demonstrate the feasibility of performance improvement.

FY 2007 Plans:

- Complete research into using polymer gel electrolytes and novel air electrodes in next generation metal air batteries to demonstrate the feasibility of performance improvement.
- Initiate research into developing a replaceable electrode battery power source that consists of a metallic structure that is consumed during power generation and then easily replaced with a new metallic component that restores a full charge.
- Initiate research into developing an organic photovoltaic rechargeable, thin film Lithium Ion battery on a flexible substrate with onboard charging and power distribution electronics.

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	FY 2004	FY 2005	FY 2006	FY 2007
FUTURE CONCEPTS, TECHNOLOGY ASSESSMENT, AND ROADMAPPING	0	693	726	740

This activity supports the planning and integration of technology development efforts across the entire Program Element. In conjunction with the Concepts Based Capabilities System and the Marine Corps Warfighting Laboratory, unique and novel concepts for advanced Warfighting are developed and validated. Effectiveness analyses are conducted to identify the synergistic effects that can be achieved through the integration of emerging technology with innovative tactics, doctrine, and techniques. Technology Assessments are conducted to determine the supporting technologies that have the highest impact across the warfare areas, and warrant further investment within this Program Element. Technology Roadmapping is conducted to help identify opportunities to leverage technology development within the Department of the Navy and the Department of Defense, as well as, with the commercial sector and university communities. The resultant Technology Investment Strategy is developed and used to guide out-year technology development efforts.

FY 2005 Plans:

- Initiate Technology Assessments associated with the Urban Asymmetric and Expeditionary Warfare Capability Gap.
- Initiate the integrated planning of concepts and technology development.

FY 2006 Plans:

- Continue integrated planning of concepts and technology development.
- Initiate Technology Assessment of the Maneuver, and Human Performance, Training and Education Thrust Areas.
- Initiate Technology Roadmapping of the Maneuver, and Human Performance, Training and Education Thrust Areas.
- Initiate development of the Expeditionary Maneuver Warfare Investment Strategy.
- Initiate Technology Assessments within Command, Control, Communication, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR); and Firepower Thrust Areas of the Program Element.
- Initiate Technology Roadmapping Efforts within C4ISR and Firepower Thrust Areas.

FY 2007 Plans:

- Complete Technology Assessments of C4ISR and Firepower Thrust Areas.
- Complete Technology Roadmapping Efforts within C4ISR and Firepower Thrust Areas.

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PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
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- Complete Technology Assessment of the Maneuver, and Human Performance, Training and Education Thrust Areas.
- Complete Technology Roadmapping of the Maneuver, and Human Performance, Training and Education Thrust Areas.
- Continue development of the Expeditionary Maneuver Warfare Investment Strategy.
- Continue integrated planning of concepts and technology development.

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
ADVANCED LEAD ACID BATTERY DEVELOPMENT FOR MILITARY VEHICLES	961	990

FY04: This effort developed lead acid battery technology to increase the life, energy and power output of lead acid batteries used by the Marine Corps and Navy. Novel approaches were explored including the use of a horizontal plate design, and conductive additives to the electrodes. High performance batteries have improved performance to their cycle life and energy density, while maintaining high power capabilities which translated directly into cost reductions, increased efficiency and improved sea basing of naval expeditionary forces.

FY05: Continue to explore novel approaches including the use of a horizontal plate design, and conductive additives to the electrodes.

	FY 2004	FY 2005
EXPEDITIONARY FORCE INFRASTRUCTURE INITIATIVE (EFI)	0	990

The EFI2 effort is designed to develop a large placement and dispersion salt water capability, as well as an austere surface treatment capability in support of expeditionary water crossing missions. This new surface treatment approach using lightweight composite materials is particularly important in support of Marine amphibious operations in areas of extremely soluble soils. The EFI2 effort is also designed to assess and develop effective techniques for large batch processing of composite repair material in the rapid repair of airfield runways in an expeditionary environment. This will improve mission readiness by getting airfields back on line quicker. It will also reduce the use of matting on expeditionary airfields thereby decreasing damage to aircraft airframes upon landing.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602131M PROGRAM ELEMENT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY
PROJECT TITLE: MARINE CORPS LANDING FORCE TECHNOLOGY

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

PE 0601152N (In-House Laboratory Independent Research)
PE 0601153N (Defense Research Sciences)
PE 0204163N (Fleet Telecommunications (Tactical))
PE 0602235N (Common Picture Applied Research)
PE 0602782N (Mine and Expeditionary Warfare Applied Research)
PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)
PE 0603235N (Common Picture Advanced Technology)
PE 0206623M (Marine Corps Ground/Supporting Arms Systems)
PE 0603640M (Marine Corps Advanced Technology Demonstrations)
PE 0603612M (Marine Corps Mine Countermeasures)
PE 0603635M (Marine Corps Ground Combat/Support System)
PE 0206313M (Marine Corps Communications Systems)
PE 0603236N (Warfighter Sustainment Advanced Technology)

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

D. ACQUISITION STRATEGY:
Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602233N
PROGRAM ELEMENT TITLE: HUMAN SYSTEMS TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
HUMAN SYSTEMS TECHNOLOGY	1,660	1,485	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element is funded in its entirety by Congressional Adds.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602233N
PROGRAM ELEMENT TITLE: HUMAN SYSTEMS TECHNOLOGY

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
Adjustments/Undist. Reductions	-22	-15	0	0
Congressional Action	1,725	1,500	0	0
FY 2004 SBIR	-43	0	0	0
FY 2006/2007 President's Budget Submission	1,660	1,485	0	0

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602233N
PROGRAM ELEMENT TITLE: HUMAN SYSTEMS TECHNOLOGY

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
HUMAN SYSTEMS INTEGRATION/SEAPRINT	0	1,485

FY 2005 Plan: SEAPRINT ensures all aspects of Human System Integration (HSI) with respect to Navy platforms/systems are addressed and facilitates the effectiveness of HSI standards. SEAPRINT focuses on the integration of human considerations into the system acquisition to (1) enhance human/system design, (2) reduce life cycle ownership costs and (3) optimize total system performance. Funds will be used to validate HSI processes/tenets adapted for Navy platforms from the Army Imprint/Manprint Program.

	FY 2004	FY 2005
POLYKINETICS: MATERIALS, ELECTRONICS, AND COMPUTER TECHNOLOGY	1,660	0

FY 2004 Accomplishments: Investigated thermoplastic coating systems that meet naval materials requirements in areas such as corrosion, erosion, adhesion/edge retention, fire resistance, and repairability.

C. OTHER PROGRAM FUNDING SUMMARY: Not applicable.

D. ACQUISITION STRATEGY: Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602234N
PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS AND COMPUTER TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
MATERIALS, ELECTRONICS AND COMPUTER TECHNOLOGY	1,730	3,962	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element is funded in its entirety by Congressional Adds.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602234N
PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS AND COMPUTER TECHNOLOGY

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
Adjustments/Undist. Reductions	-22	-38	0	0
Congressional Action	1,800	4,000	0	0
FY 2004 SBIR	-48	0	0	0
FY 2006/2007 President's Budget Submission	1,730	3,962	0	0

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602234N
PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS AND COMPUTER TECHNOLOGY

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
DOD AGILE MANUFACTURING CENTER FOR CASTINGS TECHNOLOGY AT NUWC KEYPORT	0	990

FY 2005 Plan: Effort will support the DoD Agile Manufacturing Center for Castings Technology at the Naval Undersea Warfare Center, Newport, RI.

	FY 2004	FY 2005
FORMABLE ALIGNED CARBON THERMOSETS (FACTS)	0	1,486

FY 2005 Plan: Effort will develop data and information required to design and fabricate parts for Navy aircraft using the Formable Aligned Carbon ThermoSet (FACT) material.

	FY 2004	FY 2005
POROUS MATERIALS	0	1,486

FY 2005 Plan: This effort will determine the corrosion-fatigue crack growth kinetics, study the stress-corrosion cracking resistance and investigate the deformation processes and cracking mechanisms in bi-modal grain structured aluminum alloys. This work is essential to efforts to utilize new, very high strength aluminum alloys in future Navy and Marine Corp combat vehicles and ships. It will provide data on fatigue and stress corrosion cracking on nanostructured aluminum alloys.

	FY 2004	FY 2005
VIRTUAL COMPANY (VC) LINK	1,730	0

FY 2004 Accomplishments: This effort expanded ongoing applied research of the West Virginia High-Technology Consortium Foundation previously sponsored by plus-ups in FY 1997 and 2001. The FY 2004 effort funded the development and demonstration of an advanced Navy Technology Transition Portal prototype. This network facilitates the flow of new technology among naval, other government, and commercial applications, and thereby

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602234N
PROGRAM ELEMENT TITLE: MATERIALS, ELECTRONICS AND COMPUTER TECHNOLOGY

fosters robust businesses in the region. The Department of the Navy's goal was 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.

C. OTHER PROGRAM FUNDING SUMMARY: Not applicable.

D. ACQUISITION STRATEGY: Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N
PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
COMMON PICTURE APPLIED RESEARCH	87,928	102,107	57,693	63,141	52,154	57,442	54,536	58,050

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

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

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N
PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	95,432	60,134	72,612	75,504
Cong Rescissions/Adjustments/Undist. Reductions	0	-1,006	0	0
Congressional Action	0	43,000	0	0
Execution Adjustments	-5,280	0	0	0
FNC Realignment	0	0	-18,425	-16,105
Non-Pay Inflation Adjustments	-89	0	0	0
Program Adjustments	0	-21	-54	-52
Program Realignment	0	0	3,451	3,299
Rate Adjustments	0	0	109	495
SBIR Assessment	-2,135	0	0	0
FY 2006/2007 President's Budget Submission	87,928	102,107	57,693	63,141

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
COMMON PICTURE APPLIED RESEARCH	87,928	102,107	57,693	63,141	52,154	57,442	54,536	58,050

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

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
KNOWLEDGE SUPERIORITY AND ASSURANCE	18,897	17,871	4,579	4,930

Knowledge Superiority and Assurance (KSA) explores fundamental technologies that enhance the Navy’s capability to exploit, manage and integrate complex, heterogeneous, multi-source information for the next generation common picture. Science and Technology (S&T) work is being focused on Navy and Marine Corps Warfighter Capability Gaps identified through analysis of operational and exercise lessons learned, as well as campaign

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
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analysis of capabilities required in the 2010-2015 time frame. Warfighter Capability Gaps being addressed by FORCEnet S&T include Combat Identification (CID), Ubiquitous Communications (Comm), Computer and Network Defense and Information Assurance (CND&IA). Office of Naval Research (ONR) has established groupings of S&T projects to incrementally provide technology input to eliminate Warfighter Gaps. These groupings are called Enabling Capabilities (EC). Each EC delivers capability-level products to acquisition in a three to five-year effort, and allocates a sufficient investment to ensure a capability is provided. For example, CID EC-1A provides cryptologic management and level one fusion capability in a Global Information Grid-compliant implementation, and transitions to the warfighter in FY05. Ubiquitous Comm provides Dynamically Managed, Interoperable, High-Capacity Connectivity wireless network technology critical to the performance and robustness of naval communications by providing higher data rates, expanded coverage to disadvantaged platforms, and improved bandwidth management. To eliminate redundancy and more accurately describe underlying S&T investments, this activity now includes investments formerly reported under Platform Protection/Electronic Warfare (EW) Systems.

This activity supports the Fleet/Force Protection (FFP) Future Naval Capability (FNC). Currently, small surface, ground and airborne platforms have little to no situation awareness (SA) or self-protection, which jeopardizes their effectiveness and survivability. The Electronic Warfare Integrated System for Small Platforms (EWISSP) program focuses on closing that gap by developing technologies to provide them with a full spectrum threat warning and countermeasures capability. This capability, when integrated with emitter identification and Low Probability of Intercept (LPI) radar detection systems, provides netted targeting information and cueing that enables self-protection. The Battlefield Ordnance Network Centric Employment (BONCE) effort will design and fabricate a compact, low cost, light weight active/passive electro-optic (EO)/infrared (IR) system for ordnance detection. The Tactical Reactive Command and Control (C2W)/Electronic Attack (EA) Network effort will develop and demonstrate a self-adapting, spatially distributed EA network for C2W.
There are several FNC efforts that completed in FY05 and three efforts transitioning to other PEs in FY06.

FY 2004 Accomplishments:

• Conducted successful Sea Trial Limited Technology Experiment using Extensible Tactical Communications, Command, Control, Computers, and Intelligence (C4I) Framework (XTCF) with Analytic Support Architecture (ASA), Environmental Visualization (EVIS) and Sea Combat Commander Module (SCCM) for Embarked Staff acting as plug-ins to test applications integrated into a net centric enterprise services system.
• Conducted successful testing of Dynamic Reconfiguration of Link 16 Network Controller and Time Slot

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

allocation protocol on USS STENNIS and with F-14/E-2C aircraft. Transition completed to Acquisition Program Manager for Link 16 (PMW-159).
• Completed Transitions of Knowledge Web Technologies (KWT) to PMW-157, Universal Data Exchange Manager (UDEM) to Common Undersea Picture Program Executive Office Integrated Warfare Systems (PEOIWS), Middleware to Submarine Advanced Processor Build-Tactical-03 (PMS-425).
• Completed transition of Human Alerting and Interruption Logistics Surface Ship (HAIL-SS) to AEGIS Open Architecture Baseline (PMS-400).
• Completed transition of Sea Combat Commander Module for Embarked Staff to PMS-411 AN/SQQ-89 Surface Ship Undersea Warfare Combat System and the AN/SSQ-121 Computer –aided Dead Reckoning Tracer (CADRT)
• Completed transition to Knowing What We Know (KWWK) to the Information Warfare Mission Planning and Command and Control (C2) Targeting System (IMPACTS) IW Mission Planner as part of the Cryptologic Unified Build (CUB).
• Completed laboratory performance explorations of a lightweight EO/IR subsystem in preparation for Unmanned Aerial Vehicle (UAV) employment for BONCE.
• Completed development of subsystem software interface algorithms for the 90-degree Shipboard Laser Acquisition System (SBLAS) system and continue exploration and refinement of the subsystem interface software for the EWISSP effort.
• Continued refinement of Cryptologic Management and Analysis Support System (CMASS) with testing in an operational environment.
• Continued refinement of Environmental Visualization (EVIS) to develop forecasting algorithms to provide information less than an hour old for strike operations as well as Meteorology and Oceanography (METOC) forecasting tool for surface, subsurface and Special Operations Forces (SOF).
• Initiated the Automated Digital Networking System (ADNS)/Teleport/Global Information Grid Bandwidth Expansion (GIG-BE) to integrate ADNS III into Department of Defense (DoD) teleports.
• Initiated Dynamic Bandwidth Resource Manager to automate link and network monitoring in ship’s radio room.
• Initiated eXtensible Common Operational Picture (XCOP) to conduct Net Centric Enterprise Services (NCES) work to establish and demonstrate a Common Operational Picture (XCOP) with data management framework that enables more rapid and timely technical and developmental exploitation of emerging, complex, and heterogeneous data sources for the Common Picture in a Service Oriented Architecture.
• Initiated Rapid Maritime Identification and Tracking System (RMITS) to provide bio-metric identification tools for special operations forces and Naval Boarding parties.

FY 2005 Plans:

• Complete development of CMASS software to provide a single repository for intercept data, automatic operator

BUDGET ACTIVITY: 02
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PROJECT TITLE: COMMON PICTURE APPLIED RESEARCH

alerting, and voice analysis; conduct operational test and transition to Cryptologic Unified Build (CUB) PMW-189. Follow-on effort called Processing Tactical Signal Intelligence (SIGINT) will begin in FY06 under PE 0603235N.
• Complete exploration and refinement of the subsystem interface software for the EWISSP effort.
• Continue Environmental Visualization forecasting algorithms to provide information less than an hour old for strike operations as well as Meteorology and Oceanography (METOC) forecasting tool for surface, subsurface and Special Operations Forces (SOF).
• Continue with Net Centric Enterprise Services (NCES) work to establish and demonstrate an Extensible Common Operational Picture (XCOP) with data management framework that enables more rapid and timely technical and developmental exploitation of emerging, complex, and heterogeneous data sources for the Common Picture. Transition to Global Command and Control System - Maritime (GCCS-M) (PMW-157).
• Continue to refine the ASA to improve location accuracy for air defense threats and transition to GCCS-M (PMW-157).
• Continue to refine ADNS/Teleport/GIG-BE to ensure High Assurance Internet Protocol Encryption (HAIPE) Interoperability and transition to ADNS (PMW-179).
• Continue to refine Dynamic Bandwidth Resource Manager and transition to ADNS (PMW-179).
• Continue Rapid Maritime Identification and Tracking System (RMITS) to provide bio-metric identification tools for special operations forces and Naval Boarding parties.
• Initiate effort called High Altitude Relay and Router Package to provide wide-band connectivity to tactical units in theater (moves to PE 0603271N in FY06).

FY 2006 Plans:

• Extend Environmental Visualization capabilities to large deck amphibious assault ships to support meteorological products for multiple users in support of strike operations. Complete transition to Naval Integrated Technical Environmental Subsystem (NITES) 2000 (PMW-150).
• Explore rapid course of action development using synthetic semi-automated forces for fast, large-scale, high-fidelity simulations, including models of human cognition and visualization techniques for assessing outcomes and uncertainties.
• Initiate test of the subsystem interface for the EWISSP effort.

FY 2007 Plans:

• Initiate level 2 data fusion effort focusing on Asymmetric Warfare to provide automated situation and threat

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assessment for decision support for counter-terrorist operations.
• Complete modification and testing of the subsystem interface software for the EWISSP effort.

	FY 2004	FY 2005	FY 2006	FY 2007
NETWORK COMMAND, CONTROL AND COMBAT SYSTEMS	13,223	17,032	10,553	11,607

This initiative explores development of advanced technologies that contribute to integrated decision-making and mission execution to achieve battlespace superiority. The activity emphasizes activity that leverages the power of networks to exploit information and information technology and maximizes the capability of platforms to use information to accomplish missions. This provides a force multiplier effect and supports Joint/coalition combat operations. Information integration is the primary focus. This focus examines the critical Science and Technology needs of automatic association and merger of information for unified presentation; automated recognition and cueing for significant patterns of information, computer-aided reasoning for task-oriented information dissemination; timely, accurate information and sensor fusion from heterogeneous sources; as well as supporting technologies to provide information assurance. The level of funding in FY06 decreases from FY05 because many projects will be completed and transitioning to the SYSCOMs and other sponsors.

FY 2004 Accomplishments:

• Demonstrated multi-modal image registration for multi-resolution and multi-scale image processing effort.
• Demonstrated prioritized real time data replication and dissemination algorithms to prioritize the delivery of real time information from unattended distributed sensors in support of operational missions.
• Demonstrated new techniques for providing improved computer network defense and improved situational awareness.
• Developed high accuracy mobile tracking and registration algorithms used in augmented reality systems for military operations in urban terrain (MOUT).
• Developed advanced algorithms, software tools and decision aids to handle and process large volumes of information.
• Compared alternative architectures for Theater Battlespace Command & Control.
• Designed a Quality of Service (QoS) real-time model that enables the expression of time critical concepts and level of QoS. This will be invaluable in FORCEnet and Network Centric Warfare deployments to predict where, when, and why scheduling and network bottlenecks will occur.
• Conducted laboratory demonstrations of distributed real-time networked data element replication and cross

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database comparisons Real Time Deconfliction effort.
• Completed development of technology for information presentation in Battlefield Augmented Reality Systems. (NRL)
• Continued development of technology to improve fidelity in Marine Infantry combat simulators via virtual locomotion and collision detection. (NRL)
• Initiated development of technology for improving face recognition technology via enhanced image registration software. (NRL)

FY 2005 Plans:

• Demonstrate in a FORCEnet limited objective experiment the application of new techniques of discrete optimization, statistical discrimination, and artificial intelligence for the resource allocation of weapons. Compare initial results with high fidelity physics based models for threat and anti-threat weapon systems for continued development of Anti-Air Warfare (AAW) optimization algorithms.
• Develop automated methods for identifying significant changes between temporally separated images (not video) to extend work on automatic target recognition (ATR) and pattern recognition into change detection algorithms.
• Develop and characterize new target detection and recognition algorithms to exploit higher dimensional data (spatial, temporal, and spectral) within the Network Centric Warfare (NCW) framework. Approach will utilize advanced correlation approaches to provide improved target detection and recognition performance by integrating multiple sensor measurements.
• Develop a suitable ontology for exercising large-scale distributed situational threat awareness in Naval battlespace environments.
• Develop a Case-Based Reasoning (CBR) simulation/model for implementing situation/threat awareness fusion solutions and a Bayesian Network (BN) inference engine for manipulating uncertainty and learning from data.
• Develop an initial prototype for an information sharing infrastructure that maintains data integrity and confidentiality for enclaves of networked workstations running commercial off the shelf (COTS) operating systems and applications.
• Demonstrate and conduct image registration error analysis for the multi-resolution and multi-scale image processing effort.
• Evaluate value of three dimensional techniques to enhance visualization technology.
• Conduct worst-case detection and conflict avoidance experimentation for the Real Time Deconfliction effort.
• Augment the real world information with computer-generated information in the Battlefield Augmented Reality System effort. The activity will also design a modular framework to support the system design and enable the

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insertion of custom scheduling and replication solutions. Other efforts will focus on the middleware layer to support emerging network centric sensor-to shooter systems.
• Develop algorithms with Naval/Joint imagery systems to handle video metadata, which includes Global Positioning System (GPS), and time, sensor information.
• Develop recommendations for standardizing the storage and linking of feature descriptions within a common database framework.
• Completed development of technology to improve fidelity in Marine Infantry combat simulators via virtual locomotion and collision detection. (NRL)
• Initiate development of technology for improving voice data interpretation and presentation to cope with audio information overload in Navy Systems. (NRL)
• Initiate development of technology to improve collaborative operational planning for tactical users using Head-Up Displays. (NRL)

FY 2006 Plans:

• Develop a set of algorithms and software which implements multiple platforms ATR, as well as performance characterizations and error rates leading to the development of a notional concept of operations.
• Develop sensor management algorithms that reduce the amount of labeled training data required, employing semi-supervised classifier and active learning techniques motivated by asymmetric threat, for which limited training data anticipated.
• Demonstrate predictive surface platform threat behavior algorithms and software employing techniques using pattern recognition on geospatial and attribute data and develop autonomous monitoring and reporting of high interest and anomalous maritime vessels.
• Demonstrate a trusted data store which maintains data pedigree and detects anomalies in a limited objective experiment.
• Develop a feature extraction module that segments the video based on video mosaicking.
• Build the visual thesaurus using texture features. The thesaurus construction is critical to achieving our goal of developing semantic concepts for video databases that are of interest to Navy applications and in general to DoN.
• Continue developing a hybrid CBR-BN system to exploit the mutual strengths of CBR and BN approaches in the development of a best of breed system employing multiple inferencing methods. Continue developing probabilistic graphical models for encoding expert knowledge and performing inference with uncertain and incomplete data for level 1 data fusion.
• Continue development of technology for improving face recognition technology via enhanced image registration

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software. (NRL)
• Continue development of technology for improving voice data interpretation and presentation to cope with audio information overload in Navy Systems. (NRL)
• Continue development of technology to improve collaborative operational planning for tactical users using Head-Up Displays. (NRL)

FY 2007 Plans:

• Develop algorithms and demonstrate data reduction through joint classification and feature optimization, realizing transfer of data to information, realizing A/I vis-à-vis Analog/Digital data (reduced bandwidth requirements and reduced burden on analysts and warfighters).
• Demonstrate anomaly detection, feature-based target tracking, track-to-pattern association and scoring, track-to-group clustering, pattern discovery and learning, pattern templates/descriptions and predictive modeling tools in a limited objective experiment.
• Develop an interface between the Level 1 and Level 2/3 data fusion processes.
• Develop ontology for describing a common language for the situation/threat assessment problem including asymmetric threats.
• Develop a CBR system for Level 2/3 fusion.
• Develop a Bayesian Network inference engine to support data mining.
• Extend visual thesaurus with geospatial relationships using a semantic layout model that is a novel combination of two popular statistical models: the Gaussian mixture model and the Markov random field model, to represent spatial distributions of visual features.
• Complete development technology for improving fact recognition technology via enhanced image registration software. (NRL)
• Continue development of technology for improving voice data interpretation and presentation to cope with audio information overload in Navy Systems. (NRL)
• Continue development of technology to improve collaborative operational planning for tactical users using Head-Up Displays. (NRL)

	FY 2004	FY 2005	FY 2006	FY 2007
COMMUNICATION AND NETWORKS	6,330	8,825	9,386	10,147

This initiative develops wireless communications network technologies critical to the performance and robustness of naval communications for air, ship, submarine, and land platforms. Developments include

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

FY 2004 Accomplishments:

• Completed and demonstrated bandwidth efficient line of sight (LOS) technology (BLT) waveform design and simulation, system engineering, software design, code and unit test. Both constant envelope continuous phase modulation (CPM) and non-constant envelope quadrature amplitude modulation (QAM) waveform modes have been integrated with turbo coding and tested.
• Completed tunable optical domain microwave filtering techniques for multifunction antennas.
• Completed the development and integration of the superconducting cross-correlator to technology readiness level (TRL) 4, demonstrating an all-digital RF front end that eliminates analog mixers and synthesizers, thereby reducing cost.
• Completed development of technology for self-organizing distributed sensor networks. (NRL)
• Continued improvements on the Joint Tactical Radio System (JTRS) Maritime Spectrum Awareness and Spectrum Adaptive Polyphase Waveform project. A human-machine interface (HMI) has been developed and digital signal processing (DSP) algorithms have been integrated with the polyphase channelizer. This project provides real-time DSP that enables distributed Navy networks to map and analyze the cluttered Radio Frequency (RF) environment.
• Continued efforts on Next Generation Tactical Internet Protocol (IP) Networks. Established test beds and tools for dual-stacked (coexistent IPv4/IPv6) environments. Developed several novel autoconfiguration and IP multicast approaches for mobile ad hoc network environments. Generated recommended IPv6 transition guidelines for existing Navy Automated Digital Network System (ADNS) networks.
• Conducted a collaborative demonstration of Interoperable Networks for Secure Communications (INSC) internetworking technologies based on IPv6, for allied interoperability. Demonstrated secure coalition IP network capability -- a mixture of IPv6 and IPv4 networks and applications, owned by individual coalition partners that is built as a Virtual Private Network (VPN). An INSC Symposium was organized and held at the North Atlantic Treaty Organization (NATO) Command, Control and Communications (C3) Agency in The Hague, Netherlands.
• Demonstrated high speed laser communications (2.5 gigabits per second) over a 32 mile path in a maritime

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environment; achieved 155 megabits per second in light rain and fog. (NRL)
• Initiated project to improve amplifier efficiency for Orthogonal Frequency Division Multiplexing (OFDM) signaling by reducing Peak-to-Average Power Ratio (PAPR). An OFDM-based constant envelope signal has been developed by embedding the OFDM signal within the phase of a constant envelope signal. Performance bounds have been obtained. A simple suboptimum receiver has been implemented.
• Initiated high efficiency communications transmitter design and development. Simulated and verified that out-of-band energy was eliminated. New delta-sigma circuit concepts have been developed to reduce power loss; silicon carbide switches were investigated for higher power operation.
• Initiated development of an adaptive equalizer for Ultra High Frequency (UHF) submarine communications that minimizes the effects of multipath and narrowband interference. Data from operational tests has been collected and analyzed. Filter structures have been designed, and preliminary designs have been configured for rapid prototyping on DSP.
• Initiated development of a Very High Frequency (VHF)/UHF power amplifier (PA) that provides linear amplification using nonlinear components. Commercial off the shelf (COTS) Class D switching amplifiers are being combined with DSP techniques in an innovative quadrature Linear Amplification Non-linear Components (LINC) PA architecture.
• Initiated development of technology to improve mobile, ad hoc networks via multi-agent programs. (NRL)

FY 2005 Plans:

• Complete the JTRS Maritime Spectrum Awareness and Spectrum Adaptive Polyphase Waveform by finalizing development of DSP algorithms and transitioning these algorithms to programmable JTRS platforms.
• Complete the study of Next Generation Tactical IP networks. Prototype and test a number of protocols within the established test beds, update transition papers, and continue Internet standards development and commercial interaction.
• Complete the peak-to-average ratio (PAPR) improvements for orthogonal frequency division multiplexed (OFDM signaling with constant envelope.
• Conduct work on INSC Phase II that will permit transition of INSC technologies into Navy ADNS by FY06. Complete initial research and demonstrate a number of IPv6 and IPv4 mobile networking technologies within the coalition architecture.
• Continue the development of a high efficiency communications transmitter. Enhanced efficiency with commercial filters and switches will be demonstrated.
• Continue development of nonlinear adaptive equalizer for Ultra-High Frequency (UHF) submarine communications. Begin tests to provide a proof of concept that will be tested at sea.

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• Continue the development of a Very High Frequency (VHF)/UHF Power Amplifier (PA). Demonstrate that a significant reduction in size, weight, and waste power can be achieved.
• Continue development of technology to improve mobile, ad hoc networks via multi-agent programs. (NRL)
• Continue the development of a VHF/UHF PA. Demonstrate that a significant reduction in size, weight, and waste power can be achieved
• Conduct demonstration of robotic space rendezvous using real time range imaging and target tracking in the Naval Research Laboratory's Space Robotics Laboratory. (NRL)
• Conduct research to improve tactical networks via the development of models, analysis methodologies, and simulation tools. (NRL)
• Develop the 802.11s standard that will specify a complete Enhanced Service Set (ESS) Mesh architecture, including auto configuration, dynamic broadcast/multicast/unicast routing, end user mobility, security, and integration with other 802 LANs.
• Initiate project to mature the superconducting cross-correlator to technology readiness level (TRL) 6 to enable the development of a multi-function multi-net digital-RF dehopping receiver for Link-16. This will involve the integration of High Temperature Superconductors (HTS) analog and Low Temperature Superconductors (LTS) digital circuits in a COTS two-stage cryocooler.
• Initiate optical receiver design using avalanche photo-diodes (APD) and array-detection techniques for laser communications over the sea in poor weather.
• Initiate research and development into MIMO (multiple-in-multiple-out) antenna technology and OFDM signaling to improve data throughput (500 Mbps) in strong multipath environment.
• Initiate development of a concept for recovering Global Positioning Systems (GPS) signals in a "friendly" jamming environment thus allowing GPS to be used while denying that capability to an adversary. (NRL)
• Initiate development of technologies in support of responsive micro-satellites including high speed W-band communications, compact deployable structures, and small, xenon electric propulsion systems. (NRL)

FY 2006 Plans:

• Complete and provide a proof of concept, tested at sea, for the nonlinear adaptive equalizer for UHF submarine communications, mitigating multi-path and narrow band interference. Transition to fleet by DSP software upgrades in submarine UHF receivers.
• Complete the development of an efficient VHF/UHF power amplifier using non-linear components. Transition this effort to the Joint Tactical Radio System (JTRS) program.
• Complete the development of a high efficiency communications transmitter based on delta-sigma modulation. Investigate transition path to deployment, including manufacture.

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• Complete the development of the 802.11s standard.
• Continue the design, fabrication, integration and test of superconducting cross-correlators on multi-chip modules (MCM) in the dehopping receiver for Link-16.
• Continue research and development in to MIMO (multiple-in-multiple-out) antenna technology and OFDM (orthogonal frequency division multiplexing) signaling to improve data throughput (500 Mbps) in strong multipath environments. Finish prototyping of lab models.
• Continue the development of the multi-function digital receiver for JTRS-compliant communication, based on the use of cryogenic modules.
• Continue the development of the “friendly” GPS jamming recovery technique. Assess the feasibility of actively canceling current “friendly” GPS jamming techniques (NRL)
• Continue development of micro-satellite technologies including design of W-band system for high bandwidth, low-probability-of-intercept communications. (NRL)
• Continue development of technology to improve mobile, ad hoc networks via multi-agent programs. (NRL)
• Initiate development of technology to improve tactical network SATCOM linkage and multi-user detection. (NRL)
• Develop an adaptive rate terminal to maintain laser communications in poor weather conditions.
• Increase the performance of free space laser communications to include hybrid digital/analog communications links with greater than 10X bandwidth than digital link for same power. (NRL)

FY 2007 Plans:

• Complete the cryogenic packaging, test and demonstrate direct digital dehopping of multiple Link-16 waveforms. Establish transition path to JTRS-compliant communications.
• Complete the development of an adaptive rate terminal to maintain laser communications in poor weather conditions. Test the system at NRL’s 32 km maritime Chesapeake Bay test bed. Establish transition path to fleet deployment.
• Complete research and development in MIMO (multiple-in-multiple-out) antenna technology and OFDM (orthogonal frequency division multiplexing) signaling to improve data throughput (500 Mbps) in strong multipath environments. Finish prototyping of lab models. Finish demo in urban environment. Explore possible transition to United States Marine Corps (USMC) and/or JTRS.
• Complete development of technology to improve mobile, ad hoc networks via multi-agent programs. (NRL)
• Continue the development of an adaptive rate terminal to maintain laser communications in poor weather. Test the system at NRL’s 32 km maritime lasercomm test bed.
• Continue the study of “friendly” GPS jamming techniques to include those designed specifically to minimize

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fratricide while maintaining effectiveness of jamming against threat GPS receivers (NRL)
• Continue initiated development technologies in support of responsive micro-satellites including laboratory demonstrations of optimized xenon electric propulsion system and deployable structures. (NRL)
• Continue development of advanced free space communications to include performance tests in marine environments. (NRL)
• Continue development of technology to improve tactical network SATCOM linkage and multi-user detection.(NRL)

	FY 2004	FY 2005	FY 2006	FY 2007
MULTI-SOURCE INTEGRATION AND COMBAT IDENTIFICATION	6,313	7,101	8,698	11,178

Multi-Source Integration (MSI), Advanced Sensor Netting Technology (ASNT) and Composite Combat Identification (CCID) projects address theater air and missile defense (TAMD) needs for rapid, high confidence Combat Identification (CID) of air and missile threats at long range using real time and non-real time threat attributes and intelligence information, and common to all TAMD units in theater; this activity supports the FORCEnet Future Naval Capability (FNC) Enabling Capability (EC) for Joint Combat ID. Provides coordination and engineering support to the Navy live fire demo of the Navy Advanced Area Defense Interceptor (AADI)

FY 2004 Accomplishments:

• Continued MSI project development and testing of algorithms to integrate radio frequency (RF) sensor data and correlate satellite communications (SATCOM) data in the E-2C aircraft mission computer. A single contractor was selected to complete MSI effort.
• Continued development of ASNT algorithms for integration of electronic warfare support (ES) data into the Open Architecture Track Manager in future combat systems and transmission of track ID attributes via real time sensor networks. Completed ASNT multi-level network demo in FY04.
• Continued development of CCID algorithms to correlate and fuse real time tracks with intelligence, surveillance and reconnaissance (ISR) data in Ship Signal Exploitation Equipment (SSEE)-equipped surface ships and a common reasoning algorithm CID capability to rapidly build high confidence identification of air tracks using all available ID attributes in theater. Completed CCID STORY MAKER algorithms for ISR data correlation and transitioned to the EP-3E reconnaissance aircraft program. Concurrent CCID risk reduction effort funded under PE 0602123N in FY 2004.

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FY 2005 Plans:

• Continue all efforts of FY04, including laboratory demonstrations of ASNT and CCID.
• Continue AADI planning and coordination for FY 2008 Navy Air Directed Surface to Air Missile (ADSAM) live-fire demonstration.

FY 2006 Plans:

• Continue all efforts of FY05, including demonstrations of MSI and CCID; ASNT will participate in Joint Task Force Exercise (JTFX).

FY 2007 Plans:

• Complete ASNT, CCID, and MSI development.

	FY 2004	FY 2005	FY 2006	FY 2007
HUMAN COMPUTER INTERFACE	3,775	4,763	5,416	6,020

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

FY 2004 Accomplishments:

• Developed an automated tool to diagnose and correct knowledge sharing deficiencies in collaborative command and control decision making.
• Developed a computational tool for uncertainty resolution and elicitation of unshared information in

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distributed and asynchronous team problem solving.
• Developed an instructional test bed at the Naval Postgraduate School (NPS) for integration of visual information sharing capabilities into Network-Centric Global Information Grid exercises.
• Developed and tested attention management tools for improved resumption after interruptions.
• Modeled and predicted perceptual errors associated with three dimensional (3D) versus two dimensional (2D) visual displays.
• Demonstrated significant performance improvements in detection latency and accuracy and of Combat Information Center (CIC) air defense teams attributed to geo-plot de-cluttering models and algorithms.
• Demonstrated improvements in the performance of CIC teams using the multi-modal watch-station, compared with teams using conventional watch-station consoles in responding to hostile tracks, countering ESM, issuing queries and warnings. Performance improvements are attributable to embedded task management algorithms and integrated display designs.
• Developed and demonstrated HCI design apparatus and software for determining/assessing eye scan and dwell patterns and the efficiency of display designs.
• Developed social network analysis tools for terrorist network analysis and put into real-world tests at the Joint Warfare Analysis Center and National Security Agency.
• Initiated development of cognitive computational models of multi-echelon command decision-making to define critical knowledge components for command and control.

FY 2005 Plans:

• Evaluate Latent Semantic Analysis (LSA) of operator communications as an effective metric of shared situational awareness in unmanned aerial vehicle (UAV) control teams.
• Demonstrate Electronic Card Wall (EWALL) (a computational human cognitive processing system) for representation and transfer of meaning among heterogeneous and distributed team members engaged in complex problem solving.
• Develop jointly with the Naval Air Systems Command (NAVAIR), a FORCEnet-based test bed to identify and evaluate the cognitive processes to be employed to optimize collaborative decision-making in a geographically distributed and time-delayed situation.
• Conduct model-based simulations and experiments to investigate the effectiveness of heterarchical organizational structures in network-centric operational environments in order to evaluate the implementation of FORCEnet concepts.
• Develop with the staff of the Naval War College new threat scenarios incorporating Joint Force Maritime Component Commander (JFMCC) operations, countering insurgency and humanitarian operations. These new threat

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scenarios will provide the basis for Limited Objective Experiments in the innovation Laboratory at the Naval War College.
• Develop Dynamic Network (DYNET) analysis (a terrorist network analysis tool) in operational command setting at U.S. Pacific Command.
• Improve terror network analysis decision tools for combatant command use and military planning, including testing of tools, development of metrics and validation.
• Develop a user tool to counteract perceptual errors associated with 3D perspective-view visual displays.
• Evaluate the effectiveness of a change history tool to minimize the effect of interruptions.
• Apply cognitive architecture modeling to the design of interface analysis tools.
• Initiate development of a cognitive model of human performance with 3D audio displays.

FY 2006 Plans:

• Incorporate an LSA-based tool into the NPS test bed and evaluate its performance with a Noncombatant Evacuation Operations Scenario.
• Test and validate the EWALL in a Special Operations simulation environment within the NAVAIR FORCEnet test bed.
• Conduct laboratory tests of the cognitive theory of Memory Templates in command and control team decision making using a shared virtual information surface.
• Test and validate DYNET terror network analysis tool, working with U.S. Pacific Command.
• Refine cognitive model of interaction with 3-D audio.
• Develop cognitive architecture based interface analysis tools.
• Develop human error modeling for cognitive architecture tools.
• Initiate jointly with the Air Force applied research on the integration of Information Operations in Air Control Centers.
• Initiate applied research on command and control adaptive architectures for Expeditionary Strike Groups working with OPNAV N-75B and Expeditionary Strike Group ONE, San Diego.

FY 2007 Plans:

• Improve response speed of the LSA tool to a near-interactive level and incorporate into a fleet experiment. Collect and evaluate data to validate improved speed and effectiveness of developing situational awareness.
• Incorporate the EWALL prototype into the Tactical Operations Center of a Special Operations Scenario and collect performance data to validate effectiveness.

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• Use Template theory to develop and test cognitive support tools for teams making decisions in tasks characterized by risky outcomes under normal and urgent conditions.
• Conduct jointly with the Air Force, applied research on the integration of Information Operations in Air Control Centers.
• Continue to test and validate terrorist network analysis tools to enable combatant commanders and military planners to probe key flows of resources, information, and personnel, developing what-if scenarios and novel plans of attack against networked forces.
• Incorporate 3D audio interaction model into an existing computational cognitive architecture (ACT-R).
• Apply interface analysis tools to analyzing new interface designs for specific Navy applications.
• Incorporate human error modeling in interface analysis tools.

	FY 2004	FY 2005	FY 2006	FY 2007
COMPUTING AND ADVANCED SENSING	1,348	3,923	4,047	4,153

This program activity includes Naval Research Laboratory (NRL) initiatives which support the general area of computing, advanced sensor integration, biometrics, information assurance and electronic warfare in support of fleet/force protection. This effort supports covert reliable battlespace communications and explores sensor exploitation technologies to communicate between sensors. This effort also supports spacecraft to spacecraft data exchange techniques using modulated optical retroreflectors.

FY 2004 Accomplishments:

• Completed laboratory explorations of a lightweight electro-optic/infrared sub-system for employment in an unmanned flight vehicle. (NRL)
• Continued development of signal processing techniques for digital Electronic Support Measures (ESM) receivers to detect and identify advanced radar and communication modulations in the presence of non-Gaussian interference sources. (NRL)
• Continued research in and demonstrations of modulated near-infrared (IR) optical retroreflector data transmission and receipt techniques in field experiments. (NRL)
• Continued independent high-power radar operation using spectrally clean waveforms, CW radar receiver technology (designed 500 MHz X-band Chirp transmitter, X-band canceller, and X-band receiver) and derived mathematical solutions of micro-Doppler modulations when targets have simple rotation and vibration, and conducted initial analyses of measured radar data from ballistic missile defense (BMD) targets and chaff. (NRL)

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• Initiated development of technology for improving reliable system to survive IW attacks. (NRL)
• Initiated collection of highest quality oblique hyperspectral imaging data in the world and are pursuing analysis of this short-wave IR data. (NRL)
• Initiated development of "through-the-sensor" techniques to obtain environmental information from shipboard radars. (NRL)
• Initiated the development of both conventional and unconventional SEI techniques applicable to the communications signal modulations of interest using mathematical models of the signal types and SEI algorithms. (NRL)

FY 2005 Plans:

• Complete development of signal processing techniques for digital Electronic Support Measures (ESM) receivers to detect and identify advanced radar and communication modulations in the presence of non-Gaussian interference sources. (NRL)
• Continue to develop spacecraft to spacecraft data exchange techniques using modulated optical retroreflectors, and exploit these techniques in the battlespace as well. (NRL)
• Continue development of "through-the-sensor" exploitation techniques to obtain environmental information from shipboard radars, and use of that information in nowcasting. (NRL)
• Continue to evaluate improved method to automatically account for atmospheric effects on hyperspectral data and apply anomaly detectors, matched filters, and new algorithms for hyperspectral target detection. (NRL)
• Continue development of technology for improving reliable system to survive IW attacks. (NRL)
• Continue development of SEI algorithms for communications signals by conducting lab tests and investigating combinations of precision classical parametric measurements and SEI techniques. (NRL)
• Continue construction and characterization of spectrally clean out-phased high-power transmitter using X-band monolithic microwave integrated circuit (MMIC) technology, developing CW radar receiver technology implementing wideband 500-MHz linear chirp at the X-band transmitter and BMD discrimination by performing experiments to study micro-Doppler signatures from BMD targets that undergo micro-motions. (NRL)
• Initiate development of technology to improve voice biometrics via the development of multi-dimensional, adaptive speaker verification technology. (NRL)
• Initiate development of technology for improved steganography and watermarking. (NRL)
• Initiate the design, fabrication and testing of adaptive radio frequency (RF) elements for autonomous systems in order to increase the RF performance of small stationary autonomous systems. (NRL)

FY 2006 Plans:

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• Complete development of new algorithms for hyperspectral target detection in oblique geometries. (NRL)
• Complete efforts on independent high-power radar operation, CW radar receiver technology, and BMD discrimination. (NRL)
• Continue to develop spacecraft to spacecraft data exchange techniques using modulated optical retroreflectors, and exploit these techniques in the battlespace as well. (NRL)
• Continue development of "through-the-sensor" exploitation techniques to obtain environmental information from shipboard radars, and use of that information in nowcasting. (NRL)
• Continue the design, fabrication and testing of the phased array RF elements for autonomous systems in order to increase the RF performance of small stationary autonomous systems and incorporate design in an unmanned system. (NRL)
• Continue development of SEI algorithms for communications signals by conducting Tri-Service field tests of the most effective combination of techniques. (NRL)
• Continue the implementation of a real-time anti-ship missile (ASM) state assessment capability against modern treats by embedding algorithms in a real-time processor. (NRL)
• Continue development of technology to improve voice biometrics via the development of multi-dimensional, adaptive speaker verification technology. (NRL)
• Continue development of technology for improved steganography and watermarking. (NRL)
• Continue development of technology for improving reliable system to survive IW attacks. (NRL)

FY 2007 Plans:

• Complete communications SEI by transitioning best approaches into operational Navy electronic support and electronic attack systems. (NRL)
• Complete the implementation of a real-time anti-ship missile (ASM) state assessment capability against modern threats by conducting an empirical performance evaluation and analyze system implications. (NRL)
• Complete the design, fabrication and testing of the phased array RF elements for autonomous systems with the fabrication of a prototype unmanned system. (NRL)
• Complete development of technology to improve voice biometrics via the development of multi-dimensional, adaptive speaker verification technology. (NRL)
• Continue to develop spacecraft to spacecraft data exchange techniques using modulated optical retroreflectors, demonstrate skill in using these techniques for covert, reliable battlespace communications. (NRL)
• Continue development of additional "through-the-sensor" exploitation techniques to obtain environmental

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602235N PROGRAM ELEMENT TITLE: COMMON PICTURE APPLIED RESEARCH
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information from shipboard sensors. (NRL)
• Continue development of technology for improved steagongraphy and watermarking. (NRL)
• Continue development of technology for improving reliable system to survive IW attacks. (NRL)
• Conduct testing of the integrated adaptive, unmanned vehicle phased array design. (NRL)

	FY 2004	FY 2005	FY 2006	FY 2007
TACTICAL SPACE EXPLOITATION	0	0	15,014	15,106

The Tactical Space Exploitation initiative explores the application of new technologies on small, light-weight and low-cost satellites to enhance naval warfighting capabilities taking advantage of the global access, revisit and connectivity provided by orbital platforms. Initial efforts will be aimed at developing integrated signals electronics packages to test new concepts for global ship tracking and two-way data exfiltration using next-generation Internet Protocol (IP) technology from an array of sea-based and land-based sensors. Advanced multispectral/hyperspectral electro-optical sensors will be developed to demonstrate new warfighting constructs. This program is funded for the first time in FY 2006.

FY 2006 Plans:

• Develop integration plans, algorithms and satellite concept of operations to demonstrate the integrated signals payload as a secondary payload on an FY 2007 small satellite launch.
• Initiate development of small multifunctional integrated signals electronics systems for ship tracking from space and two-way data exfiltration from distributed global sensors.
• Initiate development of a satellite-borne electro-optical sensor system for FY 2008 launch on a small satellite to test new techniques for surveillance of environments and targets of naval interest for anti-submarine warfare and mine warfare.

FY 2007 Plans:

• Continue to develop integration plans, algorithms and satellite concept of operations to demonstrate the integrated signals payload as a secondary payload on an FY 2007 small satellite launch.
• Continue development of small multifunctional integrated signals electronics systems for ship tracking from space and two-way data exfiltration from distributed global sensors.
• Continue development of a satellite-borne electro-optical sensor system for FY 2008 launch on a small satellite to test new techniques for surveillance of environments and targets of naval interest for anti-

BUDGET ACTIVITY: 02
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submarine warfare and mine warfare.

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
AIREP, FORMERLY UESA	10,344	11,490

This effort completed and installed the Radar Test Bed at Pacific Missile Range Facility (PMRF) for conducting demonstrations and experimentations at the site. This effort will develop the track adaptive processor, an IFF capability for circular arrays and a data collection capability and modify the radar for wideband capability.

	FY 2004	FY 2005
COMMON SENSOR MODULE (COSM)	1,735	1,784

Supported the development of small common sensor modules for ground forces. These sensors were networked to provide total situational awareness for the ground forces and extended the integrated picture to the rest of the forces. Prototype modules were developed and limited demonstrations conducted. Plans are to upgrade capabilities to provide for vehicle classification based on electro-magnetic emissions. Develop algorithms for classification and verify in field testing.

	FY 2004	FY 2005
EXPEDITIONARY STRIKE GROUP NETWORK (3RD FLEET)	4,089	0

The effort included installation, operator/maintenance training, and sustainment of a Tactical Component Network (TCN) on a selected Expeditionary Strike Group (ESG). ESG funds provided the basic equipment suite, software operating licenses, and technical representative support for the duration of the installation. TCN installation conducted under “temporary alteration” parameters to explore new expeditionary network configurations and collect metrics on network performance.

	FY 2004	FY 2005
M2C2	1,925	5,943

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This effort developed the operational construct and high-level system design to support Marine Corps Forces Pacific needed for an early-entry mission package for the purposes of: urban operations; halted combat operations; ship-to-shore transition; shore-to-ship transition; medevac assistance; humanitarian assistance; halted video teleconference; host nation support; and non-governmental organizations communications. This effort will develop an early entry command, control, and communications payload, with associated technologies, suitable for future insertion into the Marine Corps' to-be-selected internally transportable (in the MV-22) vehicle. It will provide on-the-move, over-the-horizon connectivity with limited terrestrial communications and command and control capabilities for the local on-site commander.

	FY 2004	FY 2005
NAIF	4,812	5,943

The Network Applications Integration Facility (NAIF) served as a global hub to support Tactical Component Network (TCN) operations, application development and integration, and expansion of TCN instantiation with the Fleet. The NAIF supported component and protocol standardization, global distribution of data, engagement coordination, and test and integration across land, sea, and air platforms. It was manned to accommodate the operating parameters dictated by Fleet needs, and organized to reflect exercise and/or operational contingencies. Contracts for support operations and sustainment emphasized Hawaiian small businesses to the maximum extent practical. Plans are to modify capabilities to integrate into the Navy’s advanced digital networking system. Use the NAIF as an exercise center for upcoming Third and Seventh Fleet demonstrations. Continue Hawaiian tech base development thorough participation of Hawaiian technology firms in Navy program interface development for use in the Tactical Component Network.

	FY 2004	FY 2005
NATIONAL CENTER FOR ADVANCED SECURE SYSTEMS RESEARCH (NCASSR)	7,206	4,953

Developed and demonstrated information assurance research efforts in monitoring, containing and preventing hostile attacks, denial of service and malicious mobile code. Funding addresses continuing advancements in comprehensive vulnerability analysis and the development of tamper-resistant hardware and software.

	FY 2004	FY 2005

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	FY 2004	FY 2005
NAVAL AUTOMATION AND INFORMATION MANAGEMENT TECHNOLOGY	961	0

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

	FY 2004	FY 2005
SEADEEP	0	2,476

Funds support technologies to demonstrate a two-way sensor data link for high data rate, low probability of intercept, communications between airborne platforms and submerged submarines. The plan is to demonstrate the use of a steerable Micro-electro Machine System to steer a laser beam in a small unmanned vehicle.

	FY 2004	FY 2005
TESTING, EVALUATION AND DEMONSTRATION OF WEBSTER	0	1,485

Webster, web-based information fusion system for counter-terrorism operations (CTO), explicitly accounts for uncertainty in data. It uses data from multiple existing INTEL and open source systems (especially the World Wide Web (WWW)) to produce a high-level information system that specifically quantifies data certainty and source reliability. Webster models each step of the normal intelligence analytical process (collect, fuse, analyze, report, and disseminate) and attempts to estimate uncertainty that arises along the way. Plans are to accelerate development and testing of Webster to support operational needs.

	FY 2004	FY 2005
THEATER UNDERSEA WARFARE INITIATIVE	5,744	7,528

This effort demonstrated the ability of various platforms to connect with and use the integrated undersea picture via Web Centric ASW, as well as integrating additional data inputs. This effort will develop Theater

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Under Sea Warfare (TUSW) Program tools with the addition of operations rehearsal simulations, enhancements to the Asset Allocation Tool (AAT), evaluation of TUSW tools in Undersea Warfare exercises and the study of composable FORCENet integration, automated extraction of asset status and Commercial Joint Mapping Tool Kit (CJMTK) cartography benefits.

	FY 2004	FY 2005
WEB-BASED TECHNOLOGY INSERTION	1,226	990

This effort took emerging web based solutions and applied them to an area such as time critical targeting and expeditionary warfare applications, and determined the effectiveness of using enterprise solutions to achieve a prescribed outcome. By use of the web based automated information management tools, this effort incorporated critical Command and Control (C2) legacy systems into the web environment. Experiments were conducted to determine efficiency and effectiveness of the architectures, both from a technical evaluation and Fleet Operator input. Plans are to upgrade capabilities to automate discovery and access functions to lower operator workload. Test to determine suitability of new tools.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:

PE 0601153N (Defense Research Sciences)
PE 0602123N (Force Protection Applied Research)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602271N (RF Systems Applied Research)
PE 0603123N (Force Protection Advanced Technology)
PE 0603235N (Common Picture Advanced Technology)
PE 0603271N (RF Systems Advanced Technology)
PE 0603609N (Conventional Munitions)
PE 0603658N (Cooperative Engagement)
PE 0603640M (USMC Advanced Technology Demonstration) (ATD)
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)

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NON-NAVY RELATED RDT&E:

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

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N
PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
WARFIGHTER SUSTAINMENT APPLIED RESEARCH	91,808	131,030	82,856	97,000	73,328	72,024	78,318	77,958

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

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

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N
PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	100,645	63,726	74,244	66,583
Cong Rescissions/Adjustments/Undist. Reductions	0	-1,268	0	0
Congressional Action	0	68,600	0	0
Execution Adjustments	-6,272	0	0	0
FNC Realignment	0	0	8,581	5,636
Non-Pay Inflation Adjustments	-93	0	4	6
Program Adjustments	0	-28	-77	-78
Program Realignment	0	0	82	24,685
Rate Adjustments	0	0	22	168
SBIR Assessment	-2,472	0	0	0
FY 2006/2007 President's Budget Submission	91,808	131,030	82,856	97,000

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
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B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
MANPOWER/PERSONNEL	4,097	2,385	2,286	3,471

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

BUDGET ACTIVITY: 02
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FY 2004 Accomplishments:

- Continued and completed Training Analysis for Land Attack Human-Computer-Interaction (HCI) prototype.
- Continued Cognitive Agents Technologies for Sailor-command negotiation in making job assignments.
- Completed psychometrics of measures, non-cognitive metrics for identifying individual differences.
- Completed 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.
- Completed testing a cohort in the Recruit Training Center and A-School and completed the data analysis from the cohort testing for the person-organization fit program.
- Completed experiments that apply auction theory to Navy incentive allocation problems in order to measure sailor preferences in volunteering for hard-to-fill jobs.
- Completed enterprise management system approach to manpower and personnel management.
- Demonstrated new microfluidic mixing and sheath flow components for atmospheric monitoring and personnel protection (NRL).

FY 2005 Plans:

- Complete Cognitive Agents Technologies reliability testing and optimization of member/command agents.
- Initiate applicant cultures and values program to test the practicality and predictive validity of socialization measures for selection into the military.
- Initiate modeling integration of forecasting/trend analysis models across the personnel enterprise.
- Initiate and complete Land Attack Training Tool analysis and design.
- Deliver optimized microfluidic components for miniaturizing and automating medical diagnostic procedures for personnel protection. (NRL)

FY 2006 Plans:

- Continue all efforts of FY2005 less those noted as completed above.
- Complete modeling integration of forecasting/trend analysis models across the personnel enterprise.
- Initiate modeling integration methodologies for sailor/marine members’ cognitive agents and distribution and assignment system portal.

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FY 2007 Plans:

- Complete applicant cultures and values program to assess the practicality and predictive validity of socialization measures for selection into the military.
- Complete modeling integration methodologies for sailor/marine members' cognitive agents and distribution and assignment system portal.

	FY 2004	FY 2005	FY 2006	FY 2007
TRAINING TECHNOLOGIES	7,839	9,135	12,594	13,435

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. The increase in funding from FY05 to FY06 is due to rebalancing of funds and the initiation of planned projects.

FY 2004 Accomplishments:

- Continued development of optimized strategies for performance aiding and training.
- Continued training aid research for Close Quarters Battle (team training), immersive interaction applications, and Computer Generated Forces (CGF) for improving training effectiveness in Virtual Environments.
- Continued research to support students (of intelligence analysis) in becoming independent users of broad-based information.
- Continued task to develop multi-agent based architectures for modeling human behavior.
- Continued program on intelligent agents for objective-based training.
- Continued development of measures to link shared cognition with team performance.
- Continued CGF task aimed at improved techniques for human cognitive and behavioral modeling.
– Completed task to improve the capability of CGF as instructional agents.
- Completed physics tutor project, including associated studies of tutoring strategies.
- Continued work on effective feedback in artificially intelligent tutoring for dynamic task environments such as anti-air warfare, instrument flying and other characteristic military tasks.

BUDGET ACTIVITY: 02
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– Initiated task to test (in a military context) newly developed techniques for automating significant parts of the processes of knowledge acquisition and engineering with the goal of reducing these activity costs by 50%.
– Initiated modeling of the integration of different military domains into a distributed Virtual Technologies and Environments Full Spectrum Combat simulation.

FY 2005 Plans:

- Continue all efforts of FY2004 less those noted as completed above.
- Complete work on effective feedback in artificially intelligent tutoring for dynamic task environments such as anti-air warfare, instrument flying and other characteristic military tasks.
- Complete research to support students (of intelligence analysis) in becoming independent users of broad-based information.
- Complete development of measures to link shared cognition with team performance.
- Initiate a systematic program of applied research addressing unanswered questions regarding effective instructional strategies in artificially intelligent tutoring.
- Initiate work on software tools to facilitate building natural language tutorial dialogs for artificially intelligent tutoring.
- Initiate task to apply recently developed learning techniques that can be used in a model interacting with its application environment to extend or refine its knowledge base and behavioral competence.
- Initiate and complete experiments evaluating the training effectiveness of algorithms.
- Initiate and complete development of user design guidelines related to mobile computing for maintenance and report detailing hardware tools to support mobile maintenance.
- Initiate and complete development of Super Manual related tools and interim report on Super Manual progress and testing results.

FY 2006 Plans:

- Continue all efforts of FY2005 less those noted as completed above.
- Complete training aid research for Close Quarters Battle (team training), immersive interaction applications, and Computer Generated Forces for improving training effectiveness in Virtual Environments.
- Complete task to develop multi-agent based architectures for modeling human behavior, improve techniques for human cognitive and behavioral modeling, and create highly realistic simulated teammates.
- Initiate field studies and user tests evaluating new features and job aiding tools.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
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FY 2007 Plans:

- Continue all efforts of FY2006 less those noted as completed above.
- Complete development of optimized strategies for performance aiding and training.
- Complete program on intelligent agents for objective-based training.
- Complete modeling of the integration of different military domains into a distributed Virtual Technologies and Environments Full Spectrum Combat simulation.

	FY 2004	FY 2005	FY 2006	FY 2007
EXPEDITIONARY LOGISTICS	0	1,980	0	0

Expeditionary Logistics addresses surface distribution considerations and supported efforts in logistics modeling and simulation. Investment focus is on replenishment in an open seaway and interfacing to commercial shipping as a force multiplier, and internal Seabase material and cargo handling and conveyance mechanisms for selective off-load. Expeditionary logistics will begin to merge this warfighting functional information and knowledge into FORCENet, focusing at the operational and tactical level. Only one year of funding was added by PBD.

FY 2004 Accomplishments:

- Not applicable.

FY 2005 Plans:

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

FY 2006 Plans:

- Not applicable.

FY 2007 Plans:

- Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

	FY 2004	FY 2005	FY 2006	FY 2007
LITTORAL COMBAT / POWER PROJECTION	264	6,361	10,927	7,553

This activity provides technologies which enhance the ability of the Navy-Marine Corps team to assure access and sustained operations in the littorals. The Littoral Combat/Power Projection Future Naval Capability (FNC) considers all the critical functions of warfighting: command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR); fires; maneuver; sustainment; and force protection. Funding increased from FY04 to FY05 due to program growth. Funding increased from FY05 to FY06 due to program maturation, testing and demonstrations and the FY07 funding decrease is due to program transitions.

FY 2004 Accomplishments:

– Initiated efforts for laser safety testing of Streak Tube Imaging Light Detection and Ranging (LIDAR) technology being developed as part of the obstacle avoidance system for the Expeditionary Fighting Vehicle (EFV). (FY 05 funding by PE 0602131M)
– Initiated and completed testing of the stabilization algorithms and auto-tracker software developed for the EX-45 Stable Gun Mount for use on Marine Corps riverine craft. Transitioned to acquisition.

FY 2005 Plans:

- Continue all efforts of FY2004 less those noted as completed above.
- Continue development of advanced weapons materials technology for use in artillery and mortar systems. (Concurrently funded by PE 0602131M).
- Continue development of Organic Light Emitting Diode (OLED) display technology for shipboard and Marine use. (Previous effort funded by PE 0602131M; concurrent effort funded by PE 0602782N; FY 06 funding by PE 0602782N)
- Initiate development of improved lightweight fire control systems interface technologies.
- Initiate development of landmine countermeasure insensitive munitions technology. (Concurrent effort funded by PE 0602131M)
- Initiate program to develop oxygen, water vapor and temperature measurement capability for safety during littoral combat (NRL).

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PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

FY 2006 Plans:

- Continue all efforts of FY2005 less those noted as completed above.
- Continue development of advanced weapons materials technology for use in artillery and mortar systems. (FY 07 effort funded by PE 0602131M)
- Continue development of light weight fire control systems interface technologies. (FY 07 effort funded by PE 0603640M)
- Continue development of advanced fires coordination and interoperability to enable MAGTF/Joint fires. (Previous effort funded by PE 0602131M)
- Continue development of network monitoring and management tools technology. (Previous efforts funded by PE 0602131M)
- Continue development of secure mobile network/secure wireless LAN technology. (Previous efforts funded by PE 0602131M)
- Complete development and transition innovative relays Beyond-Line-of-Sight (BLOS) in the areas of wideband communications and advanced modular systems. (Previous efforts funded by PE 0602131M)
- Develop carbon monoxide and hydrogen fluoride measurement capability (NRL).

FY 2007 Plans:

- Continue all efforts of FY2006 less those noted as completed above.
- Continue development of hostile fire detection and counterfire technology (Gunslinger). (Previous efforts funded by PE 0602131M)
- Initiate development of advanced naval fires technology spiral 1.
- Initiate development of improvised explosive device (IED) mitigation technology spiral 2.
- Develop fuel vapor measurement capability (NRL).

	FY 2004	FY 2005	FY 2006	FY 2007
ADVANCED NAVAL MATERIALS	7,124	13,205	11,899	12,405

Advanced Naval Materials efforts include: advanced, lightweight materials; processes to reduce weight and cost; and enhanced sonar transducers. The decrease in FY06 is due to some of the investments previously reported under this activity being reported under a new activity entitled Cost Reduction Technologies. The funding increase from FY04 to FY05 is due to NRL Core research being now included.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
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FY 2004 Accomplishments:

– Continued development of ultra light, blast resistant metallic and composite structural materials.
– Continued low cost phthalonitrile based organic resin material and hybrid composite development with improved fire resistance; and process development of fiber reinforced foam material.
– Continued development of nanotube reinforced composite materials for the improvement of their out-of-plane mechanical properties.
– Continued development of friction stir welding of steels; high strength, high toughness, affordable ship steels for weight reduction; weld processing of stainless steel; improved welding consumables; and the modeling and process control development for reduced distortion and residual stresses for affordable construction of reduced weight, survivable ships.
– Continued development of multifunctional transducer material, high-force high-strain actuators; and evaluation of advanced transducer single crystal high strain materials.
– Continued multi-laser-processing technique development for the fabrication of ultra hard materials for wear resistance applications.
– Completed development of hybrid composite materials for future Naval structures.
– Completed process development of fiber reinforced foam material for Naval application.
– Completed innovative crystal growth methodologies for low-cost high-quality single-crystal piezoelectrics.
– Completed development of electrospark deposited coatings and scratch/hole fillers for corrosion and wear applications.
- Demonstrated feasibility of cellular metal (with embedded ceramics) armor capable of defeating Kinetic Energy (KE) threats with reduced aerial density versus Rolled Homogenious Armor (RHA) armor.
– Demonstrated ability to defeat USS Cole-level underwater blasts with cellular metal panels of component aerial density comparable to current hull-materials.
– Initiated and completed a comprehensive shipboard coating study.
– Initiated development of advanced, cost-efficient joining of titanium for >25% weight reduction of large seaborne structures.
– Initiated development of advanced composites and polymers with fire resistance for ship structures.
– Initiated development of acceptance testing methodologies for advanced transducer single-crystal high-strain materials. Define standardized materials properties and composition ranges.
– Initiated development of fiber-optic Bragg grating demodulation system for structural health monitoring of ships and submarines.
– Initiated fabrication studies of pultruded sandwich structures for low cost ship structural applications.
- Developed bioactive, catalytic materials that efficiently degrade chemical agents upon contact. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

FY 2005 Plans:

- Continue all efforts of FY2004 less those noted as completed above.
– Complete development of phthalonitrile based organic resin material and hybrid composite with improved fire resistance.
– Complete development of modeling and process control for reduced weld distortion and residual stresses, reducing fabrication costs associated with welding and flame-straightening by a factor of 40%.
– Complete development of weld processing of stainless steel for non-magnetic, damage tolerant ships.
– Complete development of multifunctional transducer materials.
– Initiate development of cellular metal blast resistant panels.
– Initiate development of cellular metal ballistic armor.
– Initiate development of new environmentally friendly, affordable and structurally sound bio-composite materials and genetic manufacturing routes to enable unprecedented structural and functional qualities using conventional fabrication methods.
– Initiate development of compositional tuning of single-crystal, high-strain transducer materials, for specialized naval system applications.
– Initiate development of integrated structural composites with blast resistance, manufacturing technologies, and low-cost organic resins with improved fire resistance.

FY 2006 Plans:

- Continue all efforts of FY2005 less those noted as completed above.
- Complete development of fiber-optic Bragg grating demodulation system for structural health monitoring of ships and submarines.
- Initiate development of novel processing technologies for increasing the fatigue strength and corrosion resistance of weldments for ship structures with reduced weight and maintenance requirements.
- Initiate development of iron-based structural amorphous alloys for coatings, laminates and graded structures providing improved formability and corrosion resistance with excellent strength.
- Initiate marine titanium alloy design and development, exploiting anticipated cost reductions for high performance, reduced maintenance naval applications.
- Initiate development of continuous single wall carbon nanotube composite materials for next generation air and naval platforms.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

FY 2007 Plans:

- Continue all efforts of FY2006 less those noted as completed above.
– Complete development of high-force high-strain actuators.
– Complete fabrication studies of pultruded sandwich for low cost, high performance ship structural applications.
– Complete cellular metal blast resistant materials with full section ship hull blast evaluation.
– Initiate development of innovative sonar transducers based on high-strain, high-coupling piezoelectric single crystals.

	FY 2004	FY 2005	FY 2006	FY 2007
MEDICAL TECHNOLOGIES	14,449	11,001	8,005	8,574

This program supports the development and demonstration of field medical equipment, diagnostic capabilities and treatments; technologies to improve warfighter safety and to enhance personnel performance under adverse conditions; and systems to prevent occupational injury and disease in hazardous, deployment environments. Navy investment in these areas is essential because Navy/USMC mission needs are not adequately addressed by the civilian sector or other Federal agencies. For example, civilian emergency medicine does not address casualty stabilization during long transit times to definitive care, or the logistics of providing self/buddy-carried, life saving technologies for massive battlefield wounds. The National Institutes of Health (NIH) focuses on disease processes, not product demonstration. Programs are complementary with those of the Army and are coordinated through the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee to prevent duplication of effort. Funding decrease in FY06 is due to efforts transferred to PE 0603729N.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

FY 2004 Accomplishments:

- Continued study of drugs and devices for uncontrolled hemorrhage. Blood loss is the leading cause of preventable death of Marines in combat.
- Continued study of analgesics without adverse effects. Naval casualties are expected to “stay in the fight” as long as possible and the use of morphine removes that capability.
- Continued efforts on resuscitative fluids to increase cardiovascular function and tissue perfusion in combat casualties. Focus is to reduce mortality and morbidity from multiple organ failure, as well as reducing logistical burden associated with supplying resuscitative fluids.
- Continued applied research into medical devices for casualty monitoring. This will improve triage decisions and allocation of medical evacuation resources.
- Continued characterization of therapeutics to protect against hemorrhagic shock. Such protection would reduce the need for resuscitative fluids and relieve the logistical burden for Naval forces.
- Continued developing tests for confirmation of vaccination and diagnosis of diseases and toxin exposure. Goal is to create noninvasive tests that produce results in minutes, not hours or days.
- Continued work on shipboard injury, exposure guidelines, and engineering specifications for preventing shock-related injury. Reducing neck, spine and musculoskeletal injury will increase force readiness.
- Continued work on hearing protection systems and on improved treatment for restoring Noise-Induced Hearing Loss (NIHL). Compensation for hearing loss currently costs DoN over $70M per year.
- Continued studies on decompression sickness, to include novel approaches to the prevention, detection and treatment of decompression sickness, particularly by non-recompressive methods.
- Continued efforts to develop prophylactic agents preventing hyperbaric oxygen toxicity. Prolonged exposure to hyperbaric oxygen can be toxic to lungs, nervous system and eyes.
- Continued work on predictive measures for oxygen-induced seizures in Navy and Marine Corps divers. Real-time prediction of hyperbaric oxygen-induced seizures will improve operational capability.
- Continued efforts to assess the impact of thermal (i.e., heat and cold) stress on operational performance. Underwater thermal extremes can affect diver performance and alter risk of incurring decompression sickness.
- Completed work on standards for personal armor systems to protect from Behind Armor Blunt Trauma (BABT).
- Demonstrated waterborne microbial array (NRL).

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
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FY 2005 Plans:

- Continue all efforts of FY2004 less those noted as completed above.
- Complete study of drugs and devices for uncontrolled hemorrhage.
- Complete study of analgesics without adverse effects.
- Complete efforts on resuscitative fluids to increase cardiovascular function and tissue perfusion in combat casualties.
- Complete applied research into medical devices for casualty monitoring.
- Initiate study to characterize therapeutic interventions in wound management. Focus is to reduce morbidity resulting in a quicker return to duty and a reduction in medical resource requirements.
- Initiate studies related to optimization of diver performance. Operational performance in the undersea environment can be hampered by a variety of environmental stressors.
- Validate microbial array at the Centers for Disease Control and transition to an advanced concept technology demonstration (NRL).

FY 2006 Plans:

- Continue all efforts of FY2005 less those noted as completed above.
- Complete work on predictive measures for oxygen-induced seizures in Navy and Marine Corps divers.
- Refine microbial array capability to accelerate commercial transition pathway (NRL).

FY 2007 Plans:

- Continue all efforts of FY2006 less those noted as completed above.
- Complete studies related to optimization of diver performance.

	FY 2004	FY 2005	FY 2006	FY 2007
ENVIRONMENTAL QUALITY	2,663	2,475	3,269	3,647

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

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

FY 2004 Accomplishments:

- Completed development of “hardened” copper biosensor technology.
- Continued efforts in Navy ship ballast water exchange efficacy evaluation, evaluation of novel membranes, bioreactor startup package, development and testing of environmentally benign marine antifouling (AF) coatings, air and noise pollution abatement technologies, and automated underwater hull surface preparation.
- Initiated development and testing of new aqueous film forming foam (AFFF) formulations (without perfluoroctanylsulfonates, PFOS), studies to accurately determine input of copper into harbor environments from Navy ship hull coatings, preliminary studies for development of robotic hull bug technology for prevention of fouling, and development of non-chlorofluorocarbon/hydrochlorofluorocarbon (CFC/HCFC) cooling methodologies.

FY 2005 Plans:

- Continue all efforts of FY2004 less those noted as completed above.
- Complete CFC/HCFC cooling methodologies, Navy ship ballast water exchange efficacy evaluation, evaluation of novel membranes, and bioreactor startup package.
– Initiate far-term noise and air pollution emissions abatement technology for unrestricted operations, and microwave technology for RF plasma torch applications.

FY 2006 Plans:

- Continue all efforts of FY2005 less those noted as completed above.
- Complete evaluation of porous inserts for noise and air emissions reduction from gas turbine engines and emission control technologies for control of emissions from marine diesels.
– Initiate development of new, advanced, environmentally benign AF/AC coating systems for Navy platforms.

FY 2007 Plans:

- Continue all efforts of FY2006 less those noted as completed above.
- Complete evaluation of AFFF without PFOS, studies to determine copper input into harbors from Navy ship hull coatings and microwave plasma torch development.
– Initiate development of advanced environmentally sound technologies for shipboard waste treatment and pollution abatement systems.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

	FY 2004	FY 2005	FY 2006	FY 2007
BIOCENTRIC TECHNOLOGIES	1,065	0	1,081	1,083

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, chemical sensing in the marine environment for unexploded ordnance detection, and novel energy sources for chemical and biological sensors deployed in the littorals. There are no funds available for this activity in FY 2005.

FY 2004 Accomplishments:

- Completed investigation in development of engineered proteins for detection of trinitrotoluene (TNT) and decomposition products in seawater.
- Completed efforts in development of electrochemical methods for detection of TNT as payload to autonomous underwater vehicle.
- Completed experimental investigation of plume dynamics.
- Initiated development of sensor system for detection of explosive compounds using engineered proteins.

FY 2005 Plans:

- There are no funds available for this activity in FY 2005.

FY 2006 Plans:

- Continue all efforts of FY2004 less those noted as completed above.
- Initiate studies based on lessons learned from the Chemical Sensing in the Marine Environment Program (chemical sensing from autonomous underwater vehicles) for Special Forces operations.
- Initiate the development of novel biomimetic propulsion systems for autonomous underwater vehicles.

FY 2007 Plans:

- Continue all efforts of FY2006.

BUDGET ACTIVITY: 02
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	FY 2004	FY 2005	FY 2006	FY 2007
HIGH SPEED SEALIFT	0	9,602	10,639	12,474

Fast sealift continues to be a military priority. However, friction drag reduction is increasingly essential for long-range, large-payload Navy ships to travel at high speeds (50+ knots). The High Speed Sealift effort focuses on the design of a hydrodynamic experimentation capability to resolve questions pertaining to full-scale implementation of friction drag reduction procedures. This effort was added by OSD PDM in 2005.

FY 2004 Accomplishments:

- Not applicable.

FY 2005 Plans:

- Initiate and complete procurement of major components required to modify the existing flow facility at the William B. Morgan Large Cavitation Channel (LCC) operated by Naval Surface Warfare Center-Carderock Division in Memphis, Tennessee. These components will be used to provide increased flows and pressures within the LCC to meet the goals of high-speed drag reduction experimentation.
- Initiate development of experimentation test plans, management procedures, and system requirements.
- Initiate high-speed sea lift system studies.

FY 2006 Plans:

- Continue all efforts of FY2005 less those noted as completed above.
- Complete development of experimentation test plans, management procedures, and system requirements.
- Initiate and complete installation of major components in the LCC.
- Initiate and complete testing and certification of performance.
- Initiate experiments for high speed drag reduction.
- Initiate designs for large-scale testing of technologies, concepts, and systems.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
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FY 2007 Plans:

- Continue all efforts of FY2006 less those noted as completed above.
- Complete experiments for high speed drag reduction.
- Complete high-speed sealift system studies.
- Complete designs for large-scale testing.
- Initiate and complete large-scale assembly and testing.

	FY 2004	FY 2005	FY 2006	FY 2007
COST REDUCTION TECHNOLOGIES	6,456	6,936	8,272	9,727

Cost Reduction Technology efforts include: ultrareliable materials and sensors to reduce cost by enabling condition-based and zero maintenance capabilities; and airframe and ship corrosion efforts for advanced cost effective prevention and life cycle management technologies. This activity includes the Navy's share of the Versatile, Affordable, Advanced Turbine Engine (VAATE) program. Investments under this activity were previously reported under Advanced Naval Materials. This new activity breakout provides improved clarification of the overall investment scope.

FY 2004 Accomplishments:

- Continued development of durable new materials and thermal barrier coatings for naval gas turbine hot sections; environmental barrier coatings for ceramics/composites for gas turbine engines; new thermal barrier technology; materials and processes for high temperature turbine disks; and higher temperature aluminum alloys for propulsion.
- Continued development of road test methodology and coating test metrics for the USMC vehicles; longer-life, enhanced-performance self-priming topcoat and corrosion preventive compounds (CPC) for aircraft; and spectral imaging/thermography technology.
- Continued development of single coat corrosion control coatings for potable water ship tanks.
- Continued development of spectral imaging/thermographic Nondestructive Inspection (NDI) for aircraft.
- Continued the development of single coat corrosion control coatings for fuel tanks.
- Continued the development of single coat corrosion control coatings for collect/hold/transfer (CHT) tanks.
- Completed the development of a Nondestructive Evaluation (NDE) Technique for corrosion detection in ship pipes without the need for removal of lagging material.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
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- Completed development of oxidation resistant molybdenum alloys to provide major enhancement in performance and fuel economy for gas turbines.
- Completed the development of single coat corrosion control coatings for ballast ship tanks.
- Completed Accelerated Simulated Mission Endurance Testing (ASMET) of thermally-fatigue resistant gas turbine engine of the cooling plate.
- Completed development of longer-life, low-maintenance Modular Hybrid Pier (MHP).
- Demonstrated six times improvement in erosion-resistant coating (in gas turbine compressor blades) compounded with titanium nitride coatings.
- Completed development of corrosion and corrosivity monitoring sensors for aircraft.
- Initiated the development and evaluation of a composite propeller distributed structural health monitoring system.
- Initiated development of ultrasonic imaging NDI for aircraft.
- Initiated development of magneto-resistive NDI for aircraft.

FY 2005 Plans:

- Continue all efforts of FY2004 less those noted as completed above.
- Complete longer-life, enhanced-performance, self-priming top coat and CPC.
- Complete the development of single coat corrosion control coatings for potable water tanks.
- Complete development of spectral imaging/thermographic NDI for aircraft.
- Complete development of a next generation composite propeller distributed structural health monitoring system.
- Initiate development of ceramic matrix composite turbine blades for gas turbine engines.
- Initiate development of calcium magnesium aluminum-silicate (CMAS) resistant thermal barrier coatings.
- Initiate development of portable, real-time, wide area NDI technology for heat damage detection in composite materials.
- Initiate development of nickel-aluminized thermal barrier coating which will be phase compatible with turbine blade alloys.

FY 2006 Plans:

- Continue all efforts of FY2005 less those noted as completed above.
- Complete the development of single coat corrosion control coatings for fuel tanks.

BUDGET ACTIVITY: 02
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FY 2007 Plans:

- Continue all efforts of FY2006 less those noted as completed above.
- Complete development of standardized road test methodology and coating test metrics for the USMC vehicles.
- Complete development of single coat corrosion control coatings for CHT ship tank.
- Complete development of ultrasonic imaging NDI for aircraft.
- Complete development of magneto resistive NDI for aircraft.
- Complete development of portable, real-time, wide area NDI technology for heat damage detection in composite materials.

	FY 2004	FY 2005	FY 2006	FY 2007
SEA BASING TECHNOLOGIES	0	0	13,884	24,631

This activity includes development and advancement of technologies to support Sea Basing enablers and the future development of Sea Basing innovative naval prototypes. Areas include: advanced hull forms, propulsion, and materials to support high speed, shallow draft, and beachable connectors; innovative connector interface and transfer technologies; advanced wave and position sensors and autonomous controls to support vessel to vessel interfaces; and autonomous conveyance systems to support automated and integrated warehousing.

FY 2004 Accomplishments:

- No funds were available for this activity in FY 2004.

FY 2005 Plans:

- No funds were available for this activity in FY 2005.

BUDGET ACTIVITY: 02
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FY 2006 Plans:

- Initiate feasibility studies for beachable, high speed craft concepts, innovative vessel to vessel connector and transfer concepts, and automated and integrated warehousing concepts.
- Initiate concept design studies.
- Initiate applied research of selected emerging Sea Basing technologies which would support prototype design. Technologies include lift cushion seal challenges such as lightweight, high strength, long wear materials, variable geometry/retractability, sea state four capability as well as lighter weight, more efficient lift fans, automatic connector/mating systems, innovative seal systems, vertical/horizontal transition of conveyance and autonomous, low power consumption intraship transport systems.

FY 2007 Plans:

- Continue all efforts of FY2006 less those noted as completed above.

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
ADVANCED FOULING AND CORROSION CONTROL COATINGS FOR NAVAL VESSELS	5,384	5,547

In this effort, combinatorial research techniques are used to synthesize new polymers and formulate libraries of coatings to be evaluated for ship hull antifouling, fouling release, or anticorrosion coatings.

	FY 2004	FY 2005
ADVANCED MATERIALS AND INTELLIGENT PROCESSING CENTER	1,204	2,081

For FY04, this effort developed a resin molding process utilizing both sensor and model-based approaches. New materials provided the Navy with the capability to produce battle damage-resistant aircraft with improved stealth characteristics. For FY05, this effort develops the underlying science of Liquid Injection Processing when a multitude of material constituents are present.

BUDGET ACTIVITY: 02
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	FY 2004	FY 2005
ADVANCED REINFORCED MATERIALS AND NEW MATERIALS RESEARCH FOR AIRCRAFT TIRES	0	990

Efforts supports Advanced Reinforced Materials and New Materials Research for aircraft tires.

	FY 2004	FY 2005
AGILE VACCINOLOGY	3,951	2,972

For FY04, this effort conducted investigations on modern vaccine technologies, including DNA-based vaccines such as the malaria DNA vaccine effort that compared various vaccination strategies in animal models. For FY05, explore different genetic vaccine modalities (e.g., viral vectored, viral replicons, plasmid) for response in vitro and in animal models of infection for anthrax, plague, malaria, and dengue. Emphasis is on discovery of novel antigenic sequences in the pathogens and rapid, flexible deign of corresponding vaccines which will ultimately enable DOD to rapidly respond to threats posed by emerging pathogens or biowarfare agents.

	FY 2004	FY 2005
ALUMINUM FABRICATION UTILIZING THREE DIMENSIONAL PRINTING	1,345	1,387

In FY04, this effort defined, developed and demonstrated a three dimensional printing (3DP) system on specific DOD applications. This effort advances the potential use of the 3DP process and its unique capabilities for the manufacture of components in an e-manufacturing environment. In FY05, the objective is to expand on FY04 work.

	FY 2004	FY 2005
ATMOSPHERIC WATER HARVESTING	0	990

Effort supports Atmospheric Water Harvesting.

	FY 2004	FY 2005

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	FY 2004	FY 2005
BIOENVIRONMENTAL HAZARDS RESEARCH PROGRAM	961	0

This effort assessed 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 2004	FY 2005
BIOSENSORS FOR DEFENSE APPLICATIONS - AUTONOMOUS SENSOR PLATFORMS FOR BIOSENSING	0	1,981

Effort supports developing advanced technology for autonomous sensor platforms in marine environments.

	FY 2004	FY 2005
CARBON FOAM PROGRAM	2,046	0

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

	FY 2004	FY 2005
COASTAL AREA TACTICAL MAPPING SYSTEMS	1,923	0

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

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	FY 2004	FY 2005
COATING AND POLYMERIC FILMS FOR NAVAL APPLICATIONS	1,519	990

This effort included the development of natural polymers based on filled soybean protein/vegetable oil derivatives for possible use in a chaff cartridge; the preparation of polylactic acid/cellulose acetate blends that optimize softening point and biodegradability considerations; and the development of novel exfoliated clay reinforcements to provide physical and thermal reinforcement and a mechanism to encourage biodegradation in high salt environments.

	FY 2004	FY 2005
CUTTING TOOLS FOR AEROSPACE MATERIALS	1,808	3,368

For FY04, this effort created a virtual, collaborative environment connecting the military, industrial, and academic materials communities to support state-of-the-art aerospace materials research focused on Naval aviation issues. The primary focus was to develop and construct the user base and to integrate a consortium of partners into an electronic web-based portal. In FY05, the objective is to expand on FY04 work.

	FY 2004	FY 2005
DIAGNOSTIC TOOL FOR BIOWARFARE-INFLICTED INFECTIOUS DISEASE	1,923	0

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

	FY 2004	FY 2005
DURABILITY OF COMPOSITE MATERIALS AND STRUCTURES	0	1,287

Effort establishes the durability characteristics of composite materials used in Naval structures in the severe marine environment.

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	FY 2004	FY 2005
FIBROUS MONOLITH MATERIALS	2,402	0

This effort developed 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 2004	FY 2005
FORMABLE ALIGNED CARBON THERMOSTATS (FACTS)	1,205	0

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

	FY 2004	FY 2005
HIGH PERFORMANCE LONG LASTING LO MATERIAL FOR NAVY STEALTH APPLICATIONS	4,332	2,972

For FY04, this project developed high performance, long lasting conductive polymeric materials for Naval aircraft gap sealants for stealth applications. Conductive gap sealants based on polymers loaded with carbon nanotube offer the potential for significant improvements over current technology, specifically in weight-savings, increased absorption/deflection potential, service life, and cost. In FY05, the objective is to expand on FY04 work.

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	FY 2004	FY 2005
HUMAN SYSTEMS TECHNOLOGY	961	990

For FY04, this effort included human-centered display and interfaces to enable non-pilot operators to successfully operate unmanned combat air vehicles; supported psychophysical studies of combining tactile interfaces designed for sensory substitution (e.g. sight) and for sensory augmentation in complex dynamic environments such as aviation; developed two classes of advanced Boolean algorithms that support solutions to practical problems (e.g. scheduling, cryptography, network design); and developed data mining and optimization techniques for Navy personnel data. For FY05, this effort will support research on advanced visual displays, advanced tactile displays, and improved algorithms for knowledge discovery and data mining from large data sets.

	FY 2004	FY 2005
HYDRATE DESALINATION TECHNOLOGY	0	2,081

Effort develops a novel method to desalinate seawater using gas hydrate crystals.

	FY 2004	FY 2005
INTEGRATED BIODEFENSE RESEARCH INITIATIVE	961	0

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

	FY 2004	FY 2005
INTEGRATED WMD DETECTION AND COLLECTION SYSTEM	0	990

Effort supports Integrated WMD Detection and Collection System.

BUDGET ACTIVITY: 02
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	FY 2004	FY 2005
LOW VOLUME PRODUCTION	1,925	0

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

	FY 2004	FY 2005
MARINE MAMMAL RESEARCH PROGRAM	1,059	1,090

For FY04, this effort investigated the effects of noise on dolphin hearing (Temporary Threshold Shift) and dolphin biosonar capabilities. Additional efforts included joint visual and acoustic surveys of humpback whales in Kauai, and an internationally recognized summer graduate course in Bioacoustical Oceanography. For FY05, an assessment of dolphin hearing sensitivity using electrophysiological measurements will be conducted.

	FY 2004	FY 2005
MICROSYSTEM FUZE/SAFE & ARM DEVICES	0	990

Effort develops and implements advanced micro-system testing, characterization, and modeling and design to establish and ensure reliability standards specifically for application in Micro Electrical Mechanical Systems (MEMS) based fuzing, safety, and arming components and packaging.

	FY 2004	FY 2005
MOTION COUPLED VISUAL ENVIRONMENT (MOCOVE) FOR MOTION SICKNESS RELIEF	0	990

Effort supports Motion Coupled Visual Environment (MOCOVE) for Motion Sickness Relief (transferred from Title IV-DHP). Initiate study to test technologies for reducing the impact of motion sickness on performance in environments such as land-based Command and Control vehicles and shipboard Command Information Centers.

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	FY 2004	FY 2005
NATIONAL UNMANNED UNDERSEA VEHICLE (UUV) TEST AND EVALUATION CENTER (NUTEC)	2,687	5,844

For FY04, this effort supported 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. For FY05, Provide UUV test capability upgrades, for use by all Navy UUV programs, in four areas: (1) UUV ground-truth measurement and sensor stimulation upgrades, including tracking and target systems; (2) UUV test data management and communication systems, including remote site testing capabilities and UUV analysis systems; (3) UUV launch and recovery support systems and portable in-water test support equipment; and (4) environmental monitoring systems and upgrades to the NUTEC Test Environment Assessment Laboratory and to support UUV testing in mission-specific environments.

	FY 2004	FY 2005
NAVAL TRAINING, PERFORMANCE, AND EXPERTISE	482	990

For FY04, this effort supported applied research to improve Naval training, performance, and expertise. The primary objectives for FY05 are: 1) disseminate current and create new state-of the-art "how to" handbooks to train and educate sailors and Marines, and 2) continue research on the use of expertise models to enhance situational awareness of combat pilots under stress.

	FY 2004	FY 2005
NONLINEAR SYSTEMS RESEARCH CENTER	0	1,287

The new research institute focused in the broad area of nonlinear dynamics with specific research topical areas such as chaos-excited nondestructive evaluation, micromechanical/microfluidic devices, adaptive antenna arrays, and autonomous vehicle controls. In FY05, the damage detection effort will develop a novel device to detect damage in materials using chaotic forcing and fiber optic readout to discover changes in a material’s response. The MEMS gyros array effort is a working on-chip surface emitting laser technology for displacement sensing of a MEMS gyro array.

BUDGET ACTIVITY: 02
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	FY 2004	FY 2005
NOVEL MATERIALS SYNTHESIS AND CHARACTERIZATION	2,369	3,467

For FY04, this effort established a compact experimental facility/capability to use magnetically induced dynamic pressure for acquiring dynamic material property data over a broad range of loading conditions considerably faster and at less expense than with existing methods. This capability is exploited to determine the time scales and loading conditions associated with the initiation of mechanically stimulated metal/polymer reactions, characterize the material properties of novel structural and reactive materials, and extend the characterization capabilities to very high dynamic loading regimes. For FY05, complete assembly and integration of pulse power device. Establish and integrate time-resolved instrumentation, including multipoint visar and spectroscopic capabilities, to the pulsed power device. Conduct and implement target chamber design. Develop analytical methods to analyze wave profile data obtained from experimental measurements. Conduct material characterization experiments to determine the time scales and loading conditions associated with the initiation of mechanically stimulated metal/polymer reactions, material properties of novel structural and reactive materials. Extend the characterization capabilities to very high dynamic loading regimes.

	FY 2004	FY 2005
OPTIMIZING ADAPTIVE WARRIOR PERFORMANCE	2,017	2,081

For FY04, this effort developed a National Center for Cognitive Science recognized for excellence in manpower, personnel, and training research. The effort focused on understanding cognitive mechanisms that support adaptive warrior cognition and action. For FY05, procure dedicated magnetic resonance imaging system and conduct training and initial studies.

	FY 2004	FY 2005
PARTNERSHIP SIMULATION LAB FOR HEALTH PROFESSIONS EDUCATION	0	2,476

Effort delivers an entire authoring system for subject matter experts to create high-fidelity, persistent world simulation content that is pedagogically structured for deep and rapid experience-based learning.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

	FY 2004	FY 2005
POROUS MATERIALS RESEARCH	964	0

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

	FY 2004	FY 2005
PORTABLE LANGUAGE TRANSLATION SYSTEM AND COMPUTING PLATFORMS	2,017	0

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

	FY 2004	FY 2005
RAPID AND HIGHLY SENSITIVE DETECTION OF BIOWARFARE AGENTS	1,442	1,188

For FY04, this effort developed an inexpensive, sensitive, and reliable detector for biowarfare agents. The detector utilizes synthetic polymers incorporating molecular imprints that recognize and bind biowarfare agents and quartz crystal surfaces that, when acoustically vibrated, can detect characteristic noise generated by a bound bioagent. For FY05, semi-conducting metal oxide (SMO)-based sensors will be modified to increase sensitivity and reduce power requirements. These portable, low cost sensors will be evaluated with toxicant simulants to assess their theoretical parts-per-billion sensitivity.

	FY 2004	FY 2005
RAPID DETECTION AND RESPONSE SYSTEMS FOR BIODEFENSE	0	2,081

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

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
PROJECT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH

	FY 2004	FY 2005
SENSORNET-COMMON DATA HIGHWAY FOR COMPREHENSIVE INCIDENT MANAGEMENT FOR CBRNE THREATS	0	11,887

Effort supports the continued design and development of an information technology infrastructure toward realization of a national comprehensive incident management system. The ultimate goal of this incident management system, called SensorNet, is to provide near-real-time, reliable and secure, collection, processing, management, and dissemination of sensor data (weather, radiological, chemical and video).

	FY 2004	FY 2005
TITANIUM BASED LIQUID METAL ALLOY FOR ADVANCED AEROSPACE APPLICATIONSS	0	1,387

Effort supports identifying bulk amorphous titanium alloy compositions with high glass formability and to develop melting, casting and processing techniques to optimize alloy microstructure. Microstructural optimization will likely require controlled devitrification of crystalline regions within an amorphous matrix and processing to achieve the balance of microstructural features required for the increased ductility necessary in naval aircraft applications. This class of alloys could offer very high strength to weight ratios for use as structural members in naval aircraft, if the damage tolerance of these materials can be improved significantly.

	FY 2004	FY 2005
TITANIUM MATRIX COMPOSITES	964	1,585

For FY04, this effort developed titanium metal matrix composites to enhance future engine designs (rotating engine parts such as disks and spacers) by permitting greater thrust output to weight ratios than are achievable today with currently available materials. The application of titanium metal matrix composites will aid in achieving vertical/short take off and landing (V/STOL) aircraft designs without weight penalties. For FY05, the effort identifies bulk amorphous titanium alloy compositions with high glass formability and to develop melting, casting and processing techniques to optimize alloy microstructure.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT APPLIED RESEARCH
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	FY 2004	FY 2005
VIRTUAL CLINICAL LEARNING LAB (VCLL) FOR NURSING AND OTHER HEALTH PROFESSIONS	0	1,981

This effort supports construction of an active virtual environment infrastructure using game-based technologies and development techniques to serve as the organizing framework of a platform for post/co-didactic learning and training simulations where students and practitioners in the healthcare disciplines acquire and practice critical experiential skills.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:

PE 0308601N Modeling and Simulation Support
PE 0601103N University Research Initiatives
PE 0601152N In-House Laboratory Independent Research
PE 0601153N Defense Research Sciences
PE 0602123N Force Protection Applied Research
PE 0602747N Undersea Warfare Applied Research
PE 0603236N Warfighter Sustainment Advanced Technology
PE 0603512N Carrier Systems Development
PE 0603640M USMC Advanced Technology Demonstration (ATD)
PE 0603721N Environmental Protection
PE 0603724N Navy Energy Program
PE 0604561N SSN-21 Developments
PE 0604703N Personnel, Training, Simulation, and Human Factors
PE 0604771N Medical Development
PE 0605152N Studies and Analysis Support, Navy
PE 0708011N Industrial Preparedness

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NON-NAVY RELATED RDT&E:

PE 0408042N.SEA 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/Training Technology
PE 0602786A Warfighter Technology
PE 0602787A Medical Technology
PE 0603002A Medical Advanced Technology
PE 0603003A Aviation Advanced Technology
PE 0601102F Defense Research Sciences
PE 0602102F Materials
PE 0602202F Human Effectiveness Applied Research
PE 0602203F Aerospace Propulsion
PE 0602204F Aerospace Sensors
PE 0602702F Command Control and Communications
PE 0603216F Aerospace Propulsion and Power Technology
PE 0603716D8Z Strategic Environmental Research Program
PE 0602712E Materials and Electronics Technology
PE 0603851D8Z Environmental Security Technical Certification Program

D. ACQUISITION STRATEGY:
Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N
PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
RF SYSTEMS APPLIED RESEARCH	48,462	64,640	47,302	53,521	76,407	66,723	63,489	61,796

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. This PE supports the Future Naval Capabilities (FNC) Programs in RF Communications Technology, Supporting Technologies, and RF Electronic Warfare (EW) Technology.

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

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N
PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	49,244	49,151	54,265	54,045
Cong Rescissions/Adjustments/Undist. Reductions	0	-697	0	0
Congressional Action	0	16,200	0	0
Execution Adjustments	329	0	0	0
FNC Realignment	0	0	-6,042	-5,778
Non-Pay Inflation Adjustments	-46	0	0	0
Program Adjustments	0	-14	-45	-43
Program Realignment	0	0	-949	5,001
Rate Adjustments	0	0	73	296
SBIR Assessment	-1,065	0	0	0
FY 2006/2007 President's Budget Submission	48,462	64,640	47,302	53,521

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
RF SYSTEMS APPLIED RESEARCH	48,462	64,640	47,302	53,521	76,407	66,723	63,489	61,796

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 Program Element (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 2004	FY 2005	FY 2006	FY 2007
ELECTRONICS AND COMMUNICATIONS TECHNOLOGIES	15,676	18,924	15,968	18,936

This activity includes Future Naval Capability (FNC) investments formerly reported for RF Communications Technology, Supporting Technologies, and Radio Frequency (RF) Electronic Warfare (EW) Technology. This additional breakout provides improved detail of the underlying investment. This activity includes support to the FNC Enabling Capabilities (EC) for Long Range RF Deception Missile Defense (MD EC-1C) and Multi-Source Intelligence Surveillance, and Reconnaissance (ISR) to the Warfighter Knowledge Superiority and Assurance (KSA EC-7B).
Controls fluctuate due to completion of initiatives, technology maturing and moving into 6.3.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

FY 2004 Accomplishments:

• Conducted lab testing of the near real-time processing of the ultra-wideband chirp subsystem under the Electronic Support (ES) Detection of Low Probability of Intercept (LPI) Periscope Detection Radar effort.
• Developed and tested the frequency agile prediction algorithm for advanced seekers under the Electronic Attack (EA) Techniques to Counter Advanced Threats effort.
• Advanced Multifunction Radio Frequency Concept (AMRFC) test bed hardware delivered, integrated and tested at the Naval Research Laboratory Chesapeake Bay Detachment site. Successful demonstrations of simultaneously conducting communications (commercial x-band satellite communication (SATCOM), x-band TCDL), surface search radar, and Electronic Warfare (both ES and EA) through the same set of multifunction apertures.
• Fabricated and tested linearizers with 2 GHz of bandwidth.
• Performed full RF life tests of Silicon Carbide (SiC) discrete devices and Monolithic Microwave Integrated Circuits (MMICs).
• Broadened the database for addressing infant mortality issues in Gallium Nitride (GaN) discrete devices and began to establish approaches to RF life testing of GaN High Electron Mobility Transistors (HEMTs).
• Demonstrated a 3 port, 6-18 GHz high power handling channelizer in the laboratory (1.2 dB insertion loss).
• Model of a 6-18 GHz isolator was calibrated and then used to design 20 watt isolator with reduced losses (<1 dB). Fabrication and revised design completed.
• Demonstrated a superconducting band pass sigma delta analog-to-digital converter (ADC) with a 5 GHz center frequency.
• Increased the performance and yield of devices used in the Direct Digital Synthesizer (DDS) frequency source.
• Optimized the wide bandgap low noise receiver amplifier designs by targeting specific spectral bands and exploring approaches to the utilization of these amplifiers with reduced limiter protection.
• Continued cost reduction technical approaches critical to the development of digitally programmable RF electronics components for electronically scanned arrays in the areas of architecture, scale of integration and packaging for multifunction RF component technology and systems.

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PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

FY 2005 Plans:

• Complete Next Generation Buoyant Cable (NGBCA) and transition to development of Next Generation Communications at Speed and Depth (NGCSD) previously funded under PE 0603271N.
• 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.
• Initiate AMRFC Version 2 (V2) renamed Multi-Function Electronics Warfare (MFEW) program and aligned with DD(X), compliant to new DODI 5000.2 acquisition rules as the Technology Development Phase, to build an Electronic Warfare (EW) Advanced Development Model (ADM) for the DD(X) program using the technology from the AMRFC testbed as the basis. During this year the system design and architecture for the ADM will be decided and contracts awarded to produce the major hardware pieces. This system will maintain the scalability and multi-functionality from the AMRFC V1 program's architecture. This will enable adding the communications and radar functions when the next generation of transmit array is developed (starts in FY07 through FY11). Program will move from RF Communications Technology to Electronics and Communications Technology in FY06.
• Fabricate and test linearizers optimized with GaN high power amplifiers having a minimum of 4 GHz of bandwidth.
• Continue the effort to improve DDS and power digital to analog converter (Power-DAC) device performance and yield with a target of up to 20 GHz.
• Transfer results of initial SiC RF life tests into the manufacturing technology and initiate a second iteration of testing.
• Continue to investigate cost reduction and affordability technical approaches critical to the development of digitally programmable RF electronics components for use in electronically scanned arrays.
• Demonstrate True Time Delay (TTD) signal processing that can be integrated into DDS and Power-DAC componentry that support affordable multiGHz bandwidth RF microwave beamsteering.
• Initiate highly integrated and affordable RX component optimization supporting AMRFC/multifunction electronic warfare (MFEW) with a transition target of FY08. This include the optimization of entire component chains of low noise amplifier (LNA), ADC’s, channelizers, and radiating elements specific to the MFEW receiver, 2-D electronically scanned arrays.

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FY 2006 Plans:

• Complete Advanced Techniques Generator (ATG)/Digital Radio Frequency Memory (DRFM) laboratory waveform testing under the EA Techniques to Counter Advanced Threats effort.
• Continue development of RX components including ADCs to support AMRFC/MFEW.
• Continue development of RF technologies that support advances in receiver architecture, antenna performance, subsystem miniaturization, decoys and advanced signal processing.
• Conduct laboratory testing of the frequency modulated continuous wave (FMCW) and Advanced Phase Coded LPI radar detection subsystems with the BLQ-10(V) system.
• The Multi-Function Electronic Warfare (MFEW) program will be in production phase for the RF components of the ADM. The AMRFC V1 Testbed will be used for risk reduction and developmental testing of components as they come available from manufacturers. Software development to integrate system functions with DD(X) Total Ship Computing Environment will be conducted. Integrated with DD(X) developmental combat system will proceed.
• Establish industrial standard for RF life testing of GaN based Millimeter-Wave Integrated Circuits (MMICs) and devices and being to apply this standard to state-of-the-art (SOA) MMICs and devices.
• Demonstrate highly linear Power-DAC (or DDS linearized amplifier chain) supporting up to 20 GHz frequency and multiGHz Bandwidth at high power output levels required for AMFRC/MFEW.
• Initiate component chain optimization for AMRFC MFEW transmitter technology with a target of meeting FY11 transition target date.

FY 2007 Plans:

• Complete counter terminal and counter targeting techniques development under the EA Techniques to Counter Advanced Threats effort.
• Complete initial phase of GaN life testing with demonstration of greater than 10 hour lifetimes for 175 degree channel temperatures.
• Continue development of RF technologies that support advances in receiver architecture, antenna performance, subsystem miniaturization, decoys and advanced signal processing.
• Continue entire component chain optimization for AMRFC MFEW transmitter (TX) technology with a target of meeting FY10 transition to the AMRFC MFEW transmitter, with emphasis on affability and cost reduction of modules. This task includes optimization of the entire component chain consisting of at least the radiating element, digital synthesizer, channelizer, RF power amplifiers, isolators, beamformer, and module package. Affordable digital solutions to 20 GHz are sought after.

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PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
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• Conduct a trade off study of available and developmental two-dimensional, planar and non-planar phased array technologies for the Enhanced Nulka Payload effort.
• Initiate demonstration packaging techniques to provide cost reduction and affordability for modules, including component architecture, packaging, and scale of integration optimization.
• Demonstrate complete ARMFC/MFEW receiver (RX) component chains and modules with a target transition of FY08. A target metric of cost reduction to 1/3 of current is sought after for component chains and modules.
• MFEW program will accept, integrate and test RF components from contractors to demonstrate the EW ADM for DD(X). Testing will occur in a developmental test manner to support milestone B decision by the acquisition authority and transition of the ADM to Program Executive Office Integrated Warfare System (IWS)2 for System Development Demonstration (SDD) phase and subsequent acquisition and installation in DD(X). Testing will go through Technology readiness level (TRL) 7.

	FY 2004	FY 2005	FY 2006	FY 2007
RF ELECTRONIC WARFARE TECHNOLOGY	5,557	7,342	9,531	10,581

Supports 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; precision identification and location of threat emitters; and, development of technologies that have broad application across multiple disciplines within the EW mission area.

FY 2004 Accomplishments:

Technology development in the areas of Tactical Aircraft, Surface Ships, Submarines, Unmanned Aerial Vehicles (UAVs), and EW Enabling Technology was performed. Some specific accomplishments include:
• Completed full radio frequency-to-pulse descriptor word system functionality under the Wideband EW Channelizer effort;
• Completed portions of the Electronic Countermeasure (ECM) systems analysis and modeling for both onboard and offboard systems under the countermeasures for Wideband Antiship Threats effort;
• Continued to pursue the design and validation testing of a photonic millimeter wave detection hardware covering 20 to 40 GHz (NRL).

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• Continued development and quantitative evaluation of technology and algorithms to detect, identify, exploit and counter advanced wireless communication systems including third generation personal communication systems (PCS) by conducting flight tests of most effective/efficient techniques (NRL).
• Continued the development and demonstration of key technologies that will enable an air-launched unmanned platform carrying an advanced EW payload for the suppression of enemy air defense (SEAD) mission (NRL).
• Continued the development of key capabilities of an Autonomous millimeter wave (MMW) receiver and Coherent techniques to counter 18-40 GHz airborne threats (NRL).
• Continued development of miniature, low-cost electronic warfare devices that can be used in tactical unmanned vehicles or in unattended ground sensor and effector fields (NRL).
• Initiated the development of range/phase correction algorithms that can generate focused, distributed false images against synthetic-aperture radar (SARs) from an Electronic Attack (EA) platform (NRL) offset in range and azimuth (NRL).
• Initiated analysis and modeling to develop and refine the detailed direction findings (DF) antenna design for the Hybrid Interferometer Technology Development effort.

FY 2005 Plans:

Technology development in the areas of Tactical Aircraft, Surface Ships, Submarines, UAVs, and EW Enabling Technology continues. Some specific plans include:
• Complete the development and demonstration of key technologies that will enable an air-launched unmanned platform carrying an advanced EW payload for the suppression of enemy air defense (SEAD) mission (NRL).
• Complete the development of key capabilities of an Autonomous MMW receiver and Coherent techniques to counter 18-40 GHz airborne threats (NRL).
• Continue the development of miniature, low-cost electronic warfare devices that can be used in tactical unmanned vehicles or in unattended ground sensor and effector fields (NRL).• Continue the analysis and modeling to develop and refine the detailed direction findings (DF) antenna design for the Hybrid Interferometer Technology Development effort.
• Continue to incorporate the preliminary millimeter detection hardware into a systems concept and test against 35 GHz surrogate threat (NRL).
• Continue countermeasures technology and algorithm efforts against wireless communications and transition most useful techniques into operational Navy electronic attack (EA) systems (NRL).
• Continue the fabricating a hardware breadboard incorporating range/phase correction algorithms for offset (SAR) countermeasures (NRL).

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• Initiate the development of an integrated Digital electronic warfare (EW), electronic attack (EA) and electronic support (ES) suite using a tightly coupled common architecture (NRL).
• Initiate 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.
• Initiate and complete fabrication and perform lab demonstration of the DF antenna for the Hybrid Interferometer Technology Development effort.

FY 2006 Plans:

Technology development in the areas of Tactical Aircraft, Surface Ships, Submarines, UAVs, and EW Enabling Technology continues.
• Complete the development of miniature, low-cost electronic warfare devices that can be used in tactical unmanned vehicles or in unattended ground sensor and effector fields (NRL).
• Complete advanced wireless communication countermeasures systems technology and algorithm developments (NRL).
• Complete field test of offset SAR countermeasures hardware breadboard (NRL).
• Continue development of improvement concepts for electronic countermeasures (ECM) against advanced RF missile threats.
• Continue development, evaluation, and of test hardware independent algorithms to address known shortfalls in existing specific Emitter Identification (SEI) capabilities.
• Continue development of RF technologies that support advances in receiver architecture, antenna performance, subsystem miniaturization, decoys and advanced signal processing.
• Continue to expand the frequency coverage of the basic optical detector design up to 80Ghz and test (NRL).
• Continue the development of an integrated Digital EW, EA and ES suite (NRL).
• Initiate development of simulation capability to analyze and evaluate future countermeasure techniques.
• Initiate development of advanced signal processing architectures to assist in identification and classification of low probability of intercept (LPI) and other advanced emitter types.
• Initiate employment of modeling and simulation tools to optimize technique selection to maximum electronic attack effectiveness in counter targeting and counter surveillance operations.
• Initiate investigation of methods of improving pulse de-interleaving that will support detection and identification of complex emitters and allow sorting of multiple tracks and support of raid analysis.
• Initiate the investigation millimeter wave (MMW) technologies to support the development of off board and onboard countermeasures.

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FY 2007 Plans:

Technology development in the areas of Tactical Aircraft, Surface Ships, submarines, UAVs, and EW Enabling Technology continues.
• Complete development of capability to simulate returns from ship targets, decoys, jammers and clutter to assist in the analysis and evaluation of advanced RF countermeasures techniques.
• Complete development of extraction routines to extract modulation features of advanced waveforms that can be used for signal identification and classification.
• Complete expansion of the frequency coverage of the prior detector design up to 95Ghz and test (NRL).
• Continue development efforts in low cost receivers, digital RF memory (DRFM) and technique generators to support development of low cost EW payloads for unmanned aerial vehicles (UAVs).
• Continue investigations into MMW technologies to support the development of off board and onboard countermeasures.
• Continue development of RF technologies that support advances in receiver architecture, antenna performance, subsystem miniaturization, decoys and advanced signal processing.
• Continue fabricating and integrating Digital EW, EA and ES suite brassboard implementing algorithms in Field Programmable Gate Arrays (FPGAs) (NRL).
• Initiate implementation of advanced SEI algorithms into existing hardware using a flexible architecture that supports future widespread algorithm integration and application.

	FY 2004	FY 2005	FY 2006	FY 2007
RF SURVEILLANCE TECHNOLOGY	5,591	6,869	9,590	10,696

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.

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FY 2004 Accomplishments:

• Completed an exploded prototype of a distributed local oscillator in support of the Digital Array Radar (DAR) technology development effort.
• Completed an algorithm for characterization of advanced Non-Cooperative Target Recognition (NCTR) algorithms in congested harbor environments.
• Continued the architectural design of a one dimensional active phased array apertures for Harbor Surveillance and situational awareness.
• Demonstrated a critical enabling high power amplifier technology and lightweight cooling approach capable of supporting the Horizon Extension Sensor System (HESS) and X-band Unmanned Aerial Vehicle (UAV) efforts.
• Continued development and evaluation via simulation of an effective band-partitioned canceller of wideband interference (NRL).
• Continued designing and developing a testbed for conducting wideband jamming ECCM experiments (NRL).
• Continued developing algorithms for DARPA's KASSPER I Datacube Challenges (an airborne Ground Moving Target Imaging (GMTI) adaptive array problem). With exact knowledge one can find 192 out of 268 targets (with one false alarm). 192 out of 268 targets were detected (clairvoyance signal-processing parlance) by using internally developed data-mining techniques and algorithms. Algorithms were developed for DARPA's KASSPER II Datacube Challenges (an airborne GMTI adaptive array problem). With exact knowledge one can find 73 out of 127 targets (with one false alarm). 51 out of 127 targets were detected by using internally developed data-mining techniques and algorithms (NRL).
• Initiated Electromagnetic bandgap (EBG) structures design using computational codes and the effect of various dielectric layers were evaluated (NRL).
• Initiated development and demonstration of a broadband dual polarized array with coincident phase center and true time delay beam steering. Investigated both the single and double element methods (NRL).
• Initiated wideband experiments (NRL).

FY 2005 Plans:

• Complete development of prototype level hardware for DAR and characterize its performance at the element, sub-array and system levels. Effort will transition to the Knowledge, Superiority and Assurance (KSA) Future Naval Capability (FNC).
• Complete Radar ECCM algorithms and perform and evaluate associated wideband experiments (NRL).
• Initiate demonstrations of advanced NCTR algorithms in congested harbor environments.

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- Continue the HESS project with form factored integration of High Power Amplifier (HPA) and development of a Silicon Germanium (SiGe) downconverter in support of HESS and DAR efforts.
- Continue the development to demonstrate signal processing, waveform generation and one dimensional active phased array apertures for Harbor Surveillance and situational awareness.
- Continue the design and fabrication of EBG structures, validate computational-code designs through measurements, and test for isolation of RF waves (NRL).
- Continue broadband-array effort by designing and building an 8X8 element dual-polarized array with coincident phase center (NRL).
- Initiate the design and development of a field probe and radome assembly for a real-time calibration technique that will utilize an optical-to-RF distribution network to inject a low-level RF CW signal into each element of a phased array (NRL).

FY 2006 Plans:

- Continue the demonstrations of advanced NCTR algorithms in congested harbor environments by real time implementation of automated parameter extraction algorithms for small surface crafts.
- Continue the HESS project with form factored integration of High Power Amplifier (HPA) and development of SiGe downconverter in support of HESS and DAR efforts.
- Continue the development and testing of reconfigurable/tunable EBG structures (NRL).
- Continue the investigation of polarization compensation approaches to improve polarization purity, integrate results with 8X8 broadband element array, and demonstrate a 3:1 frequency bandwidth that can provide circular polarization and true-time-delay beam steering over large scan angles (NRL).
- Initiate the design and fabrication of a one-dimensional (1-D) planar light circuitry (PLC) network that includes optical-RF detectors and element probes and in-bed this in a small radome assembly (NRL).
- Initiate an element level digital array radar effort on down conversion and digital beam formers.

BUDGET ACTIVITY: 02
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PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

FY 2007 Plans:

• Complete demonstration of advanced NCTR algorithms in congested harbor environments by real time implementation of automated parameter extraction algorithms for small surface crafts.
• Complete the development and testing of reconfigurable/tunable EBG structures (NRL).
• Complete the investigation of polarization compensation approaches to improve polarization purity, integrate results with 8X8 broadband element array, and demonstrate a 3:1 frequency bandwidth that can provide circular polarization and true-time-delay beam steering over large scan angles (NRL).
• Continue the HESS project with form factored development of a single Down conversion Digital Beam Former (DBF) slat board demonstration utilizing SiGe components in support of HESS and Digital Array Radar efforts.
• Continue the development of an element level digital array radar effort on down conversion and digital beam.
• Continue the design, fabrication and characterization of a 2-D PLC network assembly. Develop an automated calibration procedure using this completed network (NRL).
• Initiate a harbor surveillance tracking demonstration with integrated automated parameter extraction for small surface craft identification.

	FY 2004	FY 2005	FY 2006	FY 2007
SUPPORTING TECHNOLOGIES	1,647	5,427	1,946	1,668

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. This activity includes SwampWorks efforts in FY 2005 which will develop and demonstrate technologies that address emergent and enduring operational problems in an accelerated timeframe. Swampworks initiatives to PE 0603758N in FY06 and out.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

FY 2004 Accomplishments:

• Continued digital mixer development including demonstration of 20MHz-20GHz Local Oscillator (LO) source circuit based on 20 GHz master clock.
• Completed design and compact finite bandwidth band rejector filter (NRL).
• Continued selection analog-to-digital control (ADC) modulator architectures and specific semiconductor device to be hybridized with Nb Josephson junctions.
• Behavior models and core systems identification methodology were implemented using hybrid automata models for characterizing ASCM processes of the Automated Anti-Ship Cruise Missile (ASCM) Thread Model Development effort (NRL).
• Continued collecting and analyzing propagation data at 94GHz, for various sea and climatic conditions. Full monopulse measurements (phase and amplitude) were made addressing angle of arrival due to atmospheric fluctuations (NRL).
• Continued to grow and fabrication of an npn heterojunction bipolar transistor (HBT) with an InGaSb base and AlInSbAs emitter and collector (NRL).

FY 2005 Plans:

• Continue to demonstrate in the laboratory a superconducting ADC/Programmable digital channelizer combination that derives 20MHz-20GHz Local Oscillator (LO) for digital down mixing from master clock and outputs software defined bandwidth signal centered on any center frequency in range supplied to ADC.
• Continue to demonstrate flip-chip bonding of semiconducting and superconducting devices to form a functional hybrid circuit.
• Continue developing prototype identification algorithms for the lock-logic and Electronic Counter Countermeasures (ECCM) components of the automated RF ASCM threat model (NRL).
• Continue measuring Monopulse tracking accuracy at low elevation angles using towed targets and low flying aircraft and tracking error mitigation techniques suitable for millimeter wave frequencies (NRL).
• Conduct research to enable growth, fabrication, and testing of 6.1-6.3 Angstrom HEMTS with allow alloy channels and barriers (NRL).
• Conduct efforts within Project Shield (Classified program).
• Develop and complete demonstration technologies that address emergent and enduring operational problems in an accelerated timeframe.
• Pursue development to extend the tuning range of band reject filters (NRL).

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

FY 2006 Plans:

• Complete the development of prototype identification algorithms for the lock-logic and ECCM components of the automated radio frequency (RF) ASCM threat model and document results (NRL).
• Complete the 94GHz measurement effort and determine the effect of frequency agility on the diffuse multi-path component and implement a two-antenna configuration to measure atmospheric turbulence (NRL).
• Conduct development of 6.2-6.3 Angstrom HBT operating at microwave frequencies (NRL).
• Experimentally test concepts for bias current recycling in a repeated supercell superconducting circuit.
• Prove feasibility of hybrid Nb Josephson Junction/InP HBTs ADC modulator circuits operating properly at 4K and with 10 GHz clock when the hot InP transistors are <3mm away from the active Josephson junctions.
• Increase the performance of synthetic delay lines (NRL).

FY 2007 Plans:

• Demonstrate a current recycling technology for superconducting digital circuits that is mature enough to yield a four fold reduction of bias current.
• Pursue the development of a semiconductor-based frequency selective limiter (NRL).
• Pursue novel control components for mm-wave frequencies (NRL).

	FY 2004	FY 2005	FY 2006	FY 2007
RF SOLID STATE POWER AMPLIFIERS	2,966	3,461	4,282	4,792

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.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

FY 2004 Accomplishments:

- Demonstrated silicon carbide (SiC) transistors with 300 W of output power at L-band.
- Demonstrated MBE-grown HEMT structure on a GaN substrate with record Hall mobility (NRL).
- Developed advanced transistor materials and structures to enhance amplifier efficiency with the emphasis to include development of complete monolithic integrated circuits.
- Continued development of MMW Aluminum Gallium Nitride/Gallium Nitride (AlGaN/GaN) Widebandgap High Electron Mobility Transistor (HEMT).
- Continued development of AlGaN HEMT broadband amplifiers for electronic warfare decoys with output powers up to 10 times that achieved with conventional solid state amplifiers.

FY 2005 Plans:

- Continue the development of MMW AlGaN/GaN wide bandgap HEMTs.
- Develop AlGaN HEMT broadband amplifiers with over 20W output power over the full band for electronic warfare decoys.
- Pursue further development of an InGaN HEMT with a ft*lg product of 20 GHz-microns (NRL).

FY 2006 Plans:

- Complete 4-20 GHz broad band amplifier development with 40 W demonstration.
- Develop application specific MMW AlGaN/GaN Widebandgap HEMT's that will allow AlGaN broadband amplifiers to be extended to various electronic attack applications.
- Pursue radiation effects and hardness studies of wide bandgap semiconductors (NRL).

FY 2007 Plans:

- Transition MMW AlGaN/GaN HEMTs to communications and missile seeker platforms.
- Transition broadband AlGaN/GaN amplifiers to communications and missile seeker platforms.
- Pursue further development of reliable wide bandgap semiconductors (NRL).

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

	FY 2004	FY 2005	FY 2006	FY 2007
RF VACUUM ELECTRONICS POWER AMPLIFIERS	2,589	3,461	3,442	3,727

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 techniques for power and efficiency enhancement of millimeter-wave amplifiers, multiple-beam amplifiers, notably the multi-beam klystron (MBK), and physics-based modeling and simulation.

FY 2004 Accomplishments:

- Released the large-signal time-dependent code GATOR incorporating the reflection models developed earlier for beta testing.
- Released MICHELLE v3.0 and TESLA v2.0 to the domestic vacuum electronics industry for beta testing.
- Demonstrated C-band helix Traveling Wave Tube (TWT) low-distortion performance (NRL).
- Optimized the single beam kylstron large signal code TESLA v2.0 to model multiple beams (NRL).
- Continued validation of a time-dependent, helix TWT block model with memory for modeling digital signal amplification (NRL).

FY 2005 Plans:

- Create techniques for TESLA as the design tool tailored for broadband single-beam klystron development.
- Initiate the development of a four-cavity narrow-band S-band multi-beam klystron for experiments (NRL).
- Pursue development of a high-data-rate TWT using 16 and 32 symbol quadrature amplitude modulation (QAM) (NRL).

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

FY 2006 Plans:

- Continue the development of a broad-band (~ 400 MHz) S-band multi-beam (18 beams) klystron (NRL).
- Continue developing design techniques for a high power millimeter-wave TWT with quadrupole magnetic focusing (NRL).
- Release TESLA v3.0 capable of modeling broad-band single beam klystrons.
- Release the gun/collector code MICHELLE v4.0 with improved GUI and postprocessor or beta testing.
- Release TESLA MB v1.0 capable of modeling multiple beam klystrons incorporating the effect of beam-wave interaction for each beam separately.
- Conduct four-cavity narrow-band S-band multi-beam (8-beams) klystron performance (~ 600 kW and ~ 40% efficiency) experiments (NRL).
- Upgrade the large signal code CHRISTINE3D to model strong focusing effects for beam transport.

FY 2007 Plans:

- Complete design of a high power MMW TWT with quadrupole magnetic focusing (NRL).
- Release TESLA/GENOME v.1 large signal code capable of modeling broad-band multiple beam klystrons for beta testing.
- Release the gun/collector code MICHELLE with improved interface with the large signal codes CHRISTINE and TESLA.
- Integrate the large signal codes CHRISTINE and TESLA with the gun/collector code MICHELLE.
- Conduct broad-band S-band multi-beam (18-beams) klystron component performance (NRL).
- Investigate novel approaches to miniature high power wide bandwidth devices for mmwave applications (NRL).

	FY 2004	FY 2005	FY 2006	FY 2007
RF NAVIGATION TECHNOLOGY	2,216	3,113	2,543	3,121

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.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

FY 2004 Accomplishments:

• Conducted laboratory testing to determine the effectiveness of its nulling functions of the Submarine Mast-mounted Controlled Radiation Pattern Antenna (CRPA) for the GPS.
• Developed additional, high ranking, techniques of those initially investigated Space-Time Adaptive Array Processing (STAP) for GPS antenna effort; implementation issues continued to address concerns for computational speed and performance reliability.
• Initiated a development of GPS AJ digital antenna electronics (DAE) based anti-jam systems, which use space-time adaptive processing (STAP) or space-frequency adaptive processing (SFAP); Also develop small patch antenna using low-loss ceramic materials for an array of 7 elements.

FY 2005 Plans:

• Continue DAE based anti-jam systems with small patch antenna using low-loss ceramic materials for an array of 7 elements.
• Continue to integrate STAP for GPS Antennas to one of the receiver-antenna systems developed in this task or to a system recommended by the GPS-Joint Program Office (GPS-JPO). Specific jammer types will be also addressed in this effort.
• Continue to design the STAP for GPS Antennas to one of the receiver-antenna systems developed in this activity and to strike weapon systems such as Paveway and Tactical Tomahawk.
• Conduct field testing of the Submarine Mast-mounted Controlled Radiation Pattern Antenna to determine if the laboratory performance can be achieved in a more realistic environment; conduct nulling optimization in submarine mast environment for the best broadband nulling performance.
• Initiate a development of GPS AJ processor with Poly-channelized, Code Gated Maximum Likelihood (CGML) technique to cancel the effect of a large number of jammers.
• Initiate a development of GPS AJ Antenna Electronics (AE) with low-cost analog processor technique for Direction of Arrival (DOA) estimation and nulling.
• Initiate a development of GPS AJ processor to reliably lock to the GPS carrier signal and in this way make it possible to extract very high precision positional information from the GPS receiver. Carrier slips are a measure of degraded GPS positional performance.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

FY 2006 Plans:

• Continue DAE based anti-jam systems with small patch antenna using low-loss ceramic materials for an array of 7 elements.
• Continue to integrate and test GPS anti-jam (AJ) antenna installed on strike weapon systems by using the STAP processing algorithm and assess the potential jamming mitigation; Develop beam forming/null steering techniques instead of a simple power minimization; Incorporate an algorithm to Antenna Electronics (AE) performance with the optimum sampling rate; Develop techniques to minimize the AE-induced errors on GPS signals.
• Continue to design and develop SFAP for GPS AJ antenna to improve receiver AJ performance by adding channelization to the existing Code Gated Maximum Likelihood (CGML) receiver; Evaluate the effectiveness of the Poly-Channel (PC) CGML technique by simulation and build it software radios.
• Continue to design and develop GPS AJ antenna electronics algorithm for providing AJ and jammer direction-finding capabilities; Three techniques (a low cost "analog", a high performance "digital", and a "hybrid") will be investigated for high-value platforms, where great jammer level dynamic range stresses analog-to-digital (A/D) capabilities suggesting all-digital solutions. For low-cost systems, digital control with analog weights initially appears to be cost effective. A cost-performance trade table will be generated to aid the selection of the best match for a particular application.

FY 2007 Plans:

• Continue AJ AE antenna development task, integrate testbed components and conduct chamber performance testing.
• Continue to integrate the small CRPA with SFAP/STAP Antenna Electronics; Perform RF tests with advanced threats.
• Continue to design and develop GPS AJ antenna electronics algorithm for providing nulling and DOA estimation capabilities; a low cost "analog", a high performance "digital", and a "hybrid" will be investigated for high-value platforms, where great jammer level dynamic range stresses analog-to-digital (A/D) capabilities suggesting all-digital solutions. For low-cost systems, digital control with analog weights initially appears to be cost effective. A cost-performance trade table will be generated to aid the selection of the best match for a particular application.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

	FY 2004	FY 2005	FY 2006	FY 2007
RF COMMUNICATIONS TECHNOLOGY	1,353	0	0	0

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 2004 Accomplishments:

• Completed development of the Naval Battleforce Networking (NBN) technology projects Traffic Flow Engineering and Intra-Battlegroup Wireless Networking. Successful demonstration on USS ESSEX ESG.

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
ADVANCED MICROWAVE FERRITE RESEARCH FOR RF SYSTEMS	1,442	1,188

Note: FY04 title was ADVANCED MICROWAVE FERRITE RESEARCH.

In FY04, preparation of initial sample advanced hexagonal microwave ferrites and their characterization for microwave radar circuit tuning were initiated.
For FY05, a selection of functional Perovskite oxides for passive microwave device application were deposited on both Silicon Carbide (SiC) and Gallium Nitride (GaN) wide gap semiconductors and subjected to in chemical, structural and microwave evaluation

	FY 2004	FY 2005
ADVANCED SEMICONDUCTOR MATERIALS	1,345	0

In FY04, the capability of deposition and characterization of functional oxides was advanced and microwave tuning performance investigations were initiated.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

	FY 2004	FY 2005
GALLIUM NITRATE RF POWER TECHNOLOGY	0	1,981

In FY04, this effort was funded under PE 0602114N and developed a reliable Gallium Nitride (GaN) Radio Frequency (RF) Power Technology that is more reliable and affordable by bringing 4 inch wafer processing on line and through the use of High Density Dielectric Passivation (HDDP) processes.
For FY05, improve the performance and reliability of GaN High Electron Mobility Transistors (GaN HEMTs) for RF power applications by exploiting innovative new methods for the production of GaN HEMT epitaxial material on SiC and by developing novel GaN HEMT device designs and fabrication techniques. Conduct accelerated lifetime test measurements to document improvements.

	FY 2004	FY 2005
HIGH BRIGHTNESS ELECTRONICS	2,021	1,485

In FY04, demonstrated prototype field emission electron source using back-gated structures for application to 50 W, 10 GHz vacuum electronic amplifier with 10 dB gain.
For FY05, device fabrication and material synthesis of carbon nanostructure for application to 50W, 10 GHz vacuum electronic power amplifier will be optimized.

	FY 2004	FY 2005
MARITIME SYNTHETIC RANGE	4,137	4,259

In FY04, this effort further developed the Maritime Synthetic Range by synchronizing the live systems, which replaced synthetic systems, to increase the complexity of training and testing to provide a realistic setting for joint-to-unit training with coordinated operational forces.
For FY05, this effort will develop and enhance the Maritime Synthetic Range with increased real-time participation in operational training; creation of synthetic forces; scenario generation; and creation of common synthetic battlespace (CSB) and advanced threat environments.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

	FY 2004	FY 2005
NOVEL SILICON CARBIDE TECHNOLOGY DEVELOPMENT	0	990

Techniques will be developed to provide a solid scientific framework for the growth of SiC epitaxial and bulk crystals using halo-carbon precursor gases.

	FY 2004	FY 2005
PACIFIC THEATER DATA FUSION TESTBED	0	2,476

The project will develop a Pacific-theater Data Fusion Testbed (PDFT) initiative and provide the U.S. Navy and Missile Defense Agency (MDA) with advanced discrimination and tracking capabilities. The program will develop a framework theater-wide sensor fusion center, develop multiple discrimination and tracking algorithms, and provide performance verification from development through testing. An open systems architecture will be utilized to support design integration and testing of next generation active and passive sensors, sensor data fusion, and discrimination tracking technology.

	FY 2004	FY 2005
RADAR/VIDEO FUSION VESSEL AND PORT SECURITY DEMONSTRATION	961	990

In FY04, developed techniques and algorithms for Automated Identification of vessels consistent with the Navy and Coast Guard requirements.
For FY05, use collected data to develop algorithms and automation techniques for planned autonomous operations.

	FY 2004	FY 2005
RF VACUUM ELECTRONICS POWER AMPLIFIERS	0	990

The development of design tools for the gun, collector and large signal analysis of vacuum electronics amplifiers with sheet electron beams will be initiated.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602271N PROGRAM ELEMENT TITLE: RF SYSTEMS APPLIED RESEARCH
PROJECT TITLE: RF SYSTEMS APPLIED RESEARCH

	FY 2004	FY 2005
WIDE BANDGAP MATERIALS FOR POWER ELECTRONICS	961	1,684

In FY04, improved the process to investigate the perfection of Silicon Carbide (SiC) for high power electronic applications.
For FY05, reduce thermal strain-induced structural defects (which adversely affect device performance), unintentional impurities and allow more reproducible and affordable product. This would have the effect of further improving the performance and capability of DOD's high power electronics by reducing the defect densities in power semiconductor substrates and thin device films.

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

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

D. ACQUISITION STRATEGY:
Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N
PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	56,789	69,601	49,793	50,353	51,620	52,398	53,057	54,058

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 this program are met through measuring, analyzing, modeling and simulating, and applying environmental factors affecting Naval material and operations in the BSE. This program provides for BSE technology developments that contribute to meeting top joint warfare capabilities established by the Joint Chiefs of Staff, with primary emphasis on Joint Littoral Warfare and Joint Strike Warfare.

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

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

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N
PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	62,305	48,482	56,525	55,031
Cong Rescissions/Adjustments/Undist. Reductions	0	-666	0	0
Congressional Action	0	21,800	0	0
Execution Adjustments	-3,946	0	0	0
Non-Pay Inflation Adjustments	-58	0	2	3
Program Adjustments	0	-15	-6,904	-4,954
Rate Adjustments	0	0	170	273
SBIR Assessment	-1,512	0	0	0
FY 2006/2007 President's Budget Submission	56,789	69,601	49,793	50,353

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	56,789	69,601	49,793	50,353	51,620	52,398	53,057	54,058

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

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

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

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
BATTLESPACE ENVIRONMENT (BSE) CONCEPT ENABLERS	16,677	18,869	0	0

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

The transition to new activities in this PE resulted in a 100% decrease in FY06 and FY07.

FY 2004 Accomplishments:

- Completed geoclutter effort to elucidate how the sub-sediment seafloor contributes to acoustic clutter and the importance of this environmental effect in anti-submarine warfare. Determined how variability of the sub-sediment seafloor may contribute to false targets and whether a means can be developed to reduce such false targets. (NRL)
- Continued developments, through theory and field measurement, in the air-sea interaction research effort, as a means of improving both ocean and atmospheric forecasts. (NRL)
- Continued marine mammal noise mitigation efforts to develop tools to detect and mitigate effects of noise on marine mammals, especially the noise generated by Naval activities.
- Continued the following NOPP efforts begun in earlier years: Real-Time Forecasting System of Winds, Waves, and Surge in Tropical Cyclones; The Partnership for Advancing Interdisciplinary Global Modeling (PARADIGM), a Partnership for Modeling the Marine Environment of Puget Sound, Washington, Global Ocean Data Assimilation Experiment (GODAE), Multi-Disciplinary Ocean Sensors for Environmental Analyses and Networks (MOSEAN), and Hybrid Coordinate Ocean Model (HYCOM).

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

- Continued effort to capture uncertainty in environmental predictions as a means of giving the user an idea of the reliability of those predictions. (NRL)
- Continued optimization and miniaturization of accelerometer/gravimeter systems for UUV and submarine gravity based navigation. (NRL)
- Developed techniques for observing system design, targeted observations, and data assimilation for maximum exploitation of novel and conventional observation resources in support of the tactical battlespace environment. (NRL)
- Developed a simulation prototype to analyze novel navigation and communication algorithms for multiple UUVs. (NRL)
- Completed the following NOPP effort: Development and Verification of a Comprehensive Community Model for Physical Processes in the Nearshore Ocean.

FY 2005 Plans:

- Complete development of a new global atmospheric ensemble prediction system for capturing uncertainty in environmental predictions. (NRL)
- Complete the field measurements and analysis of the air-sea interaction research effort, with the goal of improving both ocean and atmospheric forecasts. (NRL)

The following efforts transition to new activity NOPP in FY06:
- Continue marine mammal program on noise mitigation.
- Continue the following NOPP efforts begun in earlier years: Real-Time Forecasting System of Winds, Waves, and Surge in Tropical Cyclones: PARADIGM, GODAE, MOSEAN, and HYCOM.

The following efforts transition to new activity Coastal Geosciences/Optics/Biology in FY06:
- Continue optimization of algorithms for novel navigation and communications among multiple UUVs. (NRL)
- Continue optimization and miniaturization of accelerometer/gravimeter systems for UUV and submarine gravity based navigation. (NRL)
- Begin work on Advanced Techniques for Net-Centric Warfare to create a Naval Advanced METOC Broker to reliably find and broker data from new and ad-hoc METOC data providers to the warfighter in an automated manner. (NRL)
- Initiate programs in detection of fish by acoustic methods. (NRL)
- Initiate development of a Benthic Unattended (electric) Generator based on oxidation of marine organic sediment matter. (NRL)

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FY 2006 Plans:

- Program transitions to new activities as noted in FY 2005 plans.

FY 2007 Plans:

- Program transitions to new activities as noted in FY 2005 plans.

	FY 2004	FY 2005	FY 2006	FY 2007
BATTLESPACE ENVIRONMENT (BSE) SENSORS AND DATA	6,573	7,797	0	0

This activity encompasses efforts to develop new, or enhance existing, shipboard, airborne, and spaceborne sensors and appropriate inversion techniques and data handling techniques to obtain/store/manage environmental data. Data on a variety of processes in the environment are essential for several reasons: the data can serve as input to computer prediction schemes, data can be used to provide characterizations of processes for use in other developments, and data can be used in testing/validating the current understanding of ocean and atmospheric behavior. Consideration is routinely given to the basic research available in Sensors and Data to determine if new opportunities exist that can be exploited to rapidly advance toward the goals of the BSE Sensors and Data activity. Consideration is also routinely given to the nature of the technical efforts to ensure that they represent the most effective means of achieving progress. Efforts include use of organic sensors to characterize the operational environment in real-time for input into performance prediction of warfighting systems. Developments in the BSE Sensors and Data activity are of importance to littoral oceanography, amphibious warfare, MCM, 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.

The transition to new activities in this PE resulted in a 100% decrease in FY06 and FY07.

FY 2004 Accomplishments:

- Provided various measurements of the scattering function to verify that particle type retrieval can be achieved. (NRL)

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- Continued efforts to transition small, low-power, lightweight bioluminescence sensors, which are of importance to Special Operations Forces and the U.S. Naval Oceanographic Office (NAVOCEANO).
- Continued efforts to use space-based optical sensors as input for both active and passive optical MCM sensor performance prediction models.
- Continued to perform field data analysis of physics-based models for hyperspectral imaging of the ocean surface/near-surface to establish what information can be deduced about the optical properties of the ocean's upper layers. (NRL)
- Continued development of a shipboard Light detection and Ranging (LIDAR) system for measurement of winds and the near-surface Electromagnetic/Electro-optic (EM/EO) propagation environment. (NRL)
- Continued model development for diver visibility prediction in support of EOD and SPECWAR operations.
- Continued development of sensors to characterize diver visibility in support of EOD and SPECWAR operations.
- Improved physics based algorithms for characterization of seafloor sediments using acoustic returns from Navy tactical sonars and fathometers (continued application of "Through the Sensor" (TTS) techniques). (NRL)
- Continued research into ocean wave prediction, especially shoaling waves, based on the extensive basic research measurement programs in this area over the past decade, and advanced techniques such as the Higher Order Spectral Model. (NRL)
- Used particle composition information to improve estimates of diver visibility and MCM optical system performance. (NRL)
- Transitioned UV airglow-based neutral density contribution to satellite atmospheric drag to NNSOC. (NRL)
- Developed algorithms to fuse through-the-sensor surficial sediment information collected with the AQS-20 mine hunting sonar with historical surface sediment databases. (NRL)
- Continued development of innovative naval biosensors, biomaterials, and bioprocess technology.

FY 2005 Plans:

The following efforts transition to new activity Coastal Geosciences/Optics/Biology in FY06:
- Continue bioluminescence sensor effort with emphasis on needs of the Special Warfare (SPECWAR) forces and NAVOCEANO, survey capabilities, and use of the bioluminescence sensors in joint field measurements with ocean sensors to determine persistence of the bioluminescence signal and the ocean factors controlling the persistence.
- Continue efforts to use space-based optical sensors as input for both active and passive optical MCM sensor performance prediction models.
- Continue to perform field data analysis of physics-based models for hyperspectral imaging of the ocean surface/near-surface to establish what information can be deduced about the optical properties of the ocean's

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upper layers.
- Continue model development for diver visibility prediction in support of EOD and SPECWAR operations.
- Continue development of sensors to characterize diver visibility in support of EOD and SPECWAR operations.
- Identify and model the dominant sources of coastal undersea environmental electric and magnetic noise, and develop methods to mitigate their affects on multiple sensor detection performance. (NRL)
- Conduct a field test of a shipborne LIDAR system for near surface environmental characterization. (NRL)
- Extend studies of ionospheric scintillation phenomena using satellite-satellite measurements providing near global coverage using the CITRIS instrument to STPSAT1 mission. (NRL)
- Continue efforts to develop and test algorithms that fuse sediment information extracted from operational sonars with historical sediment databases. (NRL)
- Continue development of innovative naval biosensors, biomaterials, and bioprocess technology.
- Initiate programs like SBIR for promising new biological and chemical sensors.
- Participate in joint field work with other AUV technology developers and users to test undersea sensors. (NRL)

The following effort transitions to new activity Physical Oceanography in FY06:
- Continue research into 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 with the ability to impact most Naval Operations and we seek as robust a prediction capability as is possible. (NRL)

FY 2006 Plans:

- Program transitions to new activities as noted in FY 2005 plans.

FY 2007 Plans:

- Program transitions to new activities as noted in FY 2005 plans.

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	FY 2004	FY 2005	FY 2006	FY 2007
OCEAN AND ATMOSPHERIC MODELING/PREDICTION AND EFFECTS	9,259	10,858	0	0

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

The transition to new activities in this PE resulted in a 100% decrease in FY06 and FY07.

FY 2004 Accomplishments:

- Completed accurate model simulations of near-bottom solitons generated by tidal flow over bathymetry, and validated the predictions with oceanographic data. (NRL)
- Continued developments in atmospheric and ocean model nowcast/forecast systems at a variety of scales (global, regional, semi-enclosed seas, local) including relocateable and nested models. (NRL)
- Continued to employ ocean models to complete 3-D acoustic simulations of space-time coherence of the acoustic field, which is a primary characteristic related to detection performance of acoustic systems.
- Continued efforts in nested models to allow for a larger domain ocean model to set boundary conditions for a smaller domain model. Incorporate high-resolution nests into the NCOM. (NRL)
- Continued development in advanced on-board ocean models to maximize the on-board forecast capabilities available to the on-scene commander.
- Pursued further developments in atmospheric effects on electromagnetics and electro-optics.
- Continued development of an end-to-end observation/analysis/prediction system for coastal aerosol and dust.
- Improved the development of an integrated hydrodynamic/acoustic propagation modeling capability by examining the significance of broadband acoustic propagation through overturning bores in phase sensitive signal processing. (NRL)

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- Initiated development of 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.

FY 2005 Plans:

- Complete first tests of coupled global and regional aerosol prediction system with data assimilation. Efforts aim to build on recent successes of the application of atmospheric modeling demonstrated in Operation Enduring Freedom.
- Complete techniques to provide scalable 3-D acoustic propagation model into Navy PE/OAML. (NRL)

The following projects transition to new activity Marine Meteorology in FY06:
- Continue developments in atmospheric effects on electromagnetics and electro-optics because of the central importance of electromagnetic and electro-optic propagation to 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.

The following projects transition to new activity Physical Oceanography in FY06:
- Continue development of efforts in atmospheric and ocean model nowcast/forecast systems at a variety of scales (global, regional, semi-enclosed seas, local) including relocateable and nested models dependent on other priorities in this area. (NRL)
- Continue to employ ocean models to complete 3-D acoustic simulations of space-time coherence of the acoustic field, which is a primary characteristic related to detection performance of acoustic systems.
- Continue development in advanced on-board ocean models to maximize the on-board forecast capabilities available to the on-scene commander.
- Extend current theory dealing with tidal variations in sound-speed to sound-speed events with strong range dependence. (NRL)
- Initiate development of predictive capability of internal wave affects on the battlespace, including affects on acoustic transmission.

BUDGET ACTIVITY: 02
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FY 2006 Plans:

- Program transitions to new activities as noted in FY 2005 plans.

FY 2007 Plans:

- Program transitions to new activities as noted in FY 2005 plans.

	FY 2004	FY 2005	FY 2006	FY 2007
NAVAL WARFARE SYSTEM-FOCUSED EFFORTS	8,205	10,486	0	0

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

The transition to new activities in this PE resulted in a 100% decrease in FY06 and FY07.

FY 2004 Accomplishments:

- Completed analysis of WESTPAC experimental data to quantify acoustic array gain degradation caused by dynamic oceanography. (NRL)
- Demonstrated a correlation-based decision feedback equalizer to improve the reliability of underwater acoustic communications. (NRL)
- Continued development in remote sensing techniques, which include passive/active optical electromagnetic acoustic techniques and derived products. (NRL)

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- Continued developments in the area of underwater acoustics and the impact of ocean dynamics on underwater acoustics because of their general importance to acoustic systems. (NRL)
- Continued developments in environmentally sensitive, physics-based decision tools and measures of effectiveness in assessment and predictive systems as a means for providing the fleet useful environmental tactical decision aids for antisubmarine warfare as well as strike and mine warfare. (NRL)
- Continued to measure/model ship wake acoustics for anti-torpedo torpedo acoustic performance prediction. (NRL)
- Continued improvements in shock physics and numerics for an explosive mine neutralization model. (NRL)
- Continued to develop ability to optimize 3-D sonar search path by incorporating environmental uncertainty into the acoustic propagation estimates. (NRL)
- Performed measurements of acoustic transmission across a surface ship wake. (NRL)
- Continued developments in the area of utilization of acoustic processing techniques to perform acoustic or geoacoustic inversion for environmental parameters, developed techniques for discrimination between environmental scatterers and target, and through-the-sensor measurements and adaptation of sensors to the environment. (NRL)
- Pursued techniques to allow determination of sediment microfabric and geotechnical properties and their exploitation in prediction of mine burial. (NRL)
- Continued techniques for analysis and exploitation of through-the-sensor technology for rapid environmental assessment in support of Sea Strike. (NRL)
- Continued development of techniques for improving high-resolution environmental fields required for chemical/biological warfare. (NRL)
- Developed a model to predict inorganic and organic particle concentrations from a remote sensing image for ASW and MIW optical system applications. (NRL)
- Developed an integrated hydrodynamic/acoustic propagation modeling capability for littoral regions to understand the effects of internal gravity waves on acoustic propagation and array performance. (NRL)

FY 2005 Plans:

- Initiate and complete geoacoustic inversion techniques by verifying predictions of rough surface scattering theories with laboratory measurements. (NRL)
- Initiate and complete explosive placement pattern for air-dropped MCM weapon systems using improved sediment shock physics models. (NRL)

The following efforts transition to new activity Coastal Geosciences/Optics/Biology in FY06:

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- Continue development in remote sensing techniques, especially the hyperspectral and motion imagery techniques in the LZ which offer new possibilities for exploitation based on previous investigation. (NRL)
- Continue development of techniques to allow determination of sediment microfabric and geotechnical properties and their exploitation in naval Warfare. (NRL)
- Initiate development of adaptive algorithms to improve MCM electro-optic sensor performance. (NRL)
- Initiate development of an underwater geo-magnetic noise model. (NRL)

The following efforts transition to new activity Ocean Acoustics in FY06:
- Continue to develop ability to optimize 3-D sonar search path by incorporating environmental uncertainty into the acoustic propagation estimates. (NRL)
- Continue analysis of experimental data sets to quantify the impact of dynamic oceanography on acoustic ASW system performance. (NRL)
- Continue development of an integrated hydrodynamic/acoustic propagation modeling capability for littoral regions to predict acoustic ASW system performance in dynamic environments. (NRL)

The following efforts transition to new activity Marine Meteorology in FY06:
- Continue development of techniques for analysis and exploitation of through-the-sensor technology for rapid environmental assessment in support of Sea Strike. (NRL)
- Continue further development of techniques for improving high-resolution environmental fields required for chemical/biological warfare. (NRL)

The following effort transitions to new activity Physical Oceanography in FY06:
- Continue developments environmentally sensitive, physics-based decision tools, and measures of effectiveness in predictive systems. (NRL)

FY 2006 Plans:

- Program transitions to new activities as noted in FY 2005 plans.

FY 2007 Plans:

- Program transitions to new activities as noted in FY 2005 plans.

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	FY 2004	FY 2005	FY 2006	FY 2007
Marine Meteorology	0	0	9,509	9,645

The marine atmosphere affects most aspects of Naval operations. This activity develops observing technologies, models, numerical weather prediction (NWP) systems and tactical decision aids (TDA) that describe the atmospheric environment and its impacts on naval sensors and operations. This activity focuses on uniquely marine aspects of atmospheric science such as air-sea interaction, coupled ocean-atmosphere modeling, electromagnetic (EM) and electro-optic (EO) propagation, coastal meteorology, tropical cyclone prediction and the use of remote sensing to obtain quantitative observations of atmospheric properties. Aspects of the atmospheric environment of particular interest include near-surface phenomena that affect refractivity, marine boundary layer dynamics that affect clouds, rain, visibility and fog, and processes that control tropical cyclone structure, track, and intensity. Objectives of this activity are improved NWP systems and TDAs that provide nowcast and forecast skill at global, regional, and tactical scales for operational support, sensor and system development, and performance prediction.

The transition from other activities in this PE resulted in a 100% increase in FY06 and FY07.

FY 2004 Accomplishments:

- Funded in other activities noted in the FY 2006 plans.

FY 2005 Plans:

- Funded in other activities noted in the FY 2006 plans.

FY 2006 Plans:

Efforts noted below transitioned from BSE Concept Enabler, Ocean and Atmospheric Modeling/Prediction and Effects, and Naval Warfare System-Focused Efforts.
- Continue development of techniques for analysis and exploitation of through-the-sensor technology for rapid environmental assessment in support of Sea Strike. (NRL)
- Continue developments in atmospheric effects on electromagnetics and electro-optics because of the central importance of electromagnetic and electro-optic propagation to many modern warfare systems.

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- Complete development of a technique for improving high-resolution environmental fields required for chemical/biological warfare defense. (NRL)
- Complete development of 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.
- Initiate exploitation of optimal methods for capturing uncertainty of environmental predictions on regional and local scales for reliability estimates of tactical parameters. (NRL)

FY 2007 Plans:

Continue all efforts of FY 2006 less those noted as completed.

	FY 2004	FY 2005	FY 2006	FY 2007
Physical Oceanography	0	0	13,217	13,409

The goal of this activity is to develop Naval tactical uses of knowledge of the physics of the ocean within the battlespace environment. This is achieved through the development of predictive models of the water mass structure, waves, currents, and air-sea interactions and developing measurement/observation technology. Other applications utilize knowledge of the interaction of the water column hydrodynamics and the acoustics to predict the undersea transmission characteristics and sources of uncertainty in these statistics. Utilizing knowledge of the ocean surface physics, the physical oceanography program seeks to exploit the combination of remotely sensed data, in-situ data, and adaptively sampled data to optimize predictions of ocean currents and water column structure. These predictions, custom databases, adaptive sampling schemes and data programs serve ASW, NSW, Sea-Basing, and mine warfare needs.

The transition from other activities in this PE resulted in a 100% increase in FY06 and FY07.

FY 2004 Accomplishments:

- Funded in other activities noted in the FY 2006 plans.

FY 2005 Plans:

- Funded in other activities noted in the FY 2006 plans.

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FY 2006 Plans:

Efforts noted below transitioned from BSE Sensors and Data, Ocean and Atmospheric Modeling/Predictions and Effects, and Naval Warfare System-Focused Efforts.
- Continue to employ ocean models to complete 3-D acoustic simulations of space-time coherence of the acoustic field, which is a primary characteristic related to detection performance of acoustic systems.
- Continue development of predictive capability of internal wave affects on the battlespace, including affects on acoustic transmission.
- Continue to develop improved 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 with the ability to impact most Naval Operations and we seek as robust a prediction capability as is possible. (NRL)
- Continue developments in atmospheric and ocean model nowcast/forecast systems at a variety of scales (global, regional, semi-enclosed seas, local) including relocateable and nested models dependent on other priorities in this area. (NRL)
- 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 nests into the NCOM. (NRL)
- Continue development in advanced on-board ocean models to maximize the on-board forecast capabilities available to the on-scene commander. (NRL)
- Continue developing environmentally sensitive, physics-based decision tools, and measures of effectiveness in predictive systems. (NRL)
- Continue to extend current theory dealing with tidal variations in sound-speed to sound-speed events with strong range dependence. (NRL)

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed.
- Initiate development of planning tools for riverine systems, and begin development of very high resolution, riverine models for SPECOPS. (NRL)

BUDGET ACTIVITY: 02
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	FY 2004	FY 2005	FY 2006	FY 2007
Coastal Geosciences/Optics/Biology	0	0	11,735	11,883

The goal of this activity is to determine the sources, distribution, and natural variability (concentration and properties) of optically important matter in the coastal ocean in support of Naval Mine, Undersea, and Special Warfare. Research investments by this activity support the development and testing of expendable and autonomous bioluminescence sensors, the continued development of extended range underwater imaging technologies, and algorithm development and testing for application to ocean color remote sensing from aircraft and space in order to characterize key features of the coastal battle space such as bathymetry, shallow-water bottom types, and the distribution of ocean water optical properties.

The transition from other activities in this PE resulted in a 100% increase in FY06 and FY07.

FY 2004 Accomplishments:

- Funded in other activities noted in the FY 2006 plans.

FY 2005 Plans:

- Funded in other activities noted in the FY 2006 plans.

FY 2006 Plans:

Efforts noted below transitioned from BSE Concept Enablers, BSE Sensors and Data, and Naval Warfare System-Focused Efforts.
- Continue to pursue techniques to allow determination of sediment microfabric and geotechnical properties and their exploitation in prediction of mine burial. (NRL)
- Continue bioluminescence sensor effort with emphasis on needs of the Special Warfare (SPECWAR) forces and NAVOCEANO, survey capabilities, and use of the bioluminescence sensors in joint field measurements with ocean sensors to determine persistence of the bioluminescence signal and the ocean factors controlling the persistence.
- Continue efforts to use space-based optical sensors as input for both active and passive optical MCM sensor performance prediction models.
- Continue programs like SBIR for promising new biological and chemical sensors.

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- Continue model development for diver visibility prediction in support of EOD and SPECWAR operations.
- Continue development of sensors to characterize diver visibility in support of EOD and SPECWAR operations.
- Continue studies of ionospheric scintillation phenomena on communications and navigation systems with inclusion and analysis of data from CITRIS and development of improved techniques for nowcasting/forecasting ionospheric disturbances. (NRL)
- Continue to refine algorithms that fuse sediment information extracted from operational sonars with historical sediment databases. (NRL)
- Continue development of innovative naval biosensors, biomaterials, and bioprocess technology.
- Continue development of gravity-based navigation by deploying a conventional gravimeter on a submarine. (NRL)
- Continue work on Advanced Techniques for Net-Centric Warfare to create a Naval Advanced METOC Broker to reliably find and broker data from new and ad-hoc METOC data providers to the warfighter in an automated manner. (NRL)
- Continue programs in detection of fish by acoustic methods.
- Continue to identify and model the dominant sources of coastal undersea environmental electric and magnetic noise and develop methods to mitigate their affects on multiple sensor detection performance. (NRL)
- Complete analysis of physics-based models for hyperspectral imaging of the ocean surface/near-surface to establish what information can be deduced about the optical properties of the ocean’s upper layers.
- Complete algorithm developments for novel navigation and communications among multiple UUVs. (NRL)
- Complete a technique using hyperspectral and motion imagery in the LZ which offer new possibilities for exploitation based on previous investigation. (NRL)
- Complete field test of a shipborne LIDAR system for near surface environmental characterization. (NRL)
- Complete development of a Benthic Unattended Generator to power an autonomous ocean environmental profiler and provide demonstration. (NRL)
- Initiate development of optical property retrieval techniques to generate sharper images from optical sensors that are often blurred by the environment. (NRL)

FY 2007 Plans:

Continue all efforts of FY 2006 less those noted as completed.
- Complete development of adaptive algorithms for image enhancement using an operation MCM electro-optic system and provide a demonstration. (NRL)
- Complete development of a Benthic Unattended Generator to power an autonomous underwater acoustic sensor node and provide a demonstration. (NRL)

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- Complete development, testing, and transition of algorithms that fuse sediment information extracted from operational sonars with historical sediment databases. (NRL)
- Complete development of gravity-based navigation and a prototype accelerometer/gravimeter system. (NRL)
- Complete development and testing of an underwater geo-magnetic noise model. (NRL)
- Complete work on Advanced Techniques for Net-Centric Warfare to create a Naval Advanced METOC Broker to reliably find and broker data from new and ad-hoc METOC data providers to the warfighter in an automated manner. (NRL)
- Initiate transition of advanced techniques for nowcasting/forecasting ionospheric disturbances to operational entities. (NRL)
- Initiate investigation of optical data assimilation methods that make use of AUV based sensors for diver visibility prediction in support of EOD and SPECWAR operations. (NRL)
- Initiate exploration of mounting hyperspectral sensors on man-carried UAVs for riverine and terrestrial target detection for SPECOPS.
- Initiate research into use of additional sensors to expand upon capability to use hyperspectral and motion imagery techniques in the LZ which offer new possibilities for exploitation based on previous investigation. (NRL)
- Expand observations and investigations of ionospheric phenomena on communications and navigation systems with development of global UV remote sensing capability of the ionosphere from geo-synchronous orbit. (NRL)

	FY 2004	FY 2005	FY 2006	FY 2007
Ocean Acoustics	0	0	5,418	5,518

This activity is dedicated to the determination of the impact of the natural ocean environment on acoustic wave phenomena in support of Naval undersea warfare and underwater force protection operations. This activity studies underwater acoustic propagation, scattering from ocean boundaries, and ambient noise issues that impact the development and employment of acoustic systems. The Littoral Zone (LZ) has been the ocean environment of greatest interest. Aspects of this environment, that greatly impact underwater acoustic systems, are the shallow water included in the LZ, the consequent closeness and physical significance of the ocean bottom, and the complexities inherent to rapid changes of the ocean structure. The objectives of this program are met through measuring, analyzing, modeling and simulating, and exploiting ocean acoustic factors to gain advantage over potential adversaries using undersea acoustic systems. Results of this activity support acoustic sensor and system development, performance prediction, and tactical decision aids.

The transition from other activities in this PE resulted in a 100% increase in FY06 and FY07.

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FY 2004 Accomplishments:

- Funded in other activities noted in the FY 2006 plans.

FY 2005 Plans:

- Funded in other activities noted in the FY 2006 plans.

FY 2006 Plans:

Efforts noted below transitioned from Naval Warfare System-Focused Efforts.
- Continue to develop a method to optimize 3-D sonar search path by incorporating environmental uncertainty into the acoustic propagation estimates. (NRL)
- Continue development of an integrated hydrodynamic/acoustic propagation modeling capability for littoral regions to predict acoustic ASW system performance in dynamic environments. (NRL)
- Complete analysis of experimental data sets to quantify the impact of dynamic oceanography on acoustic ASW system performance. (NRL)

FY 2007 Plans:

Continue all efforts of FY 2006 less those noted as completed.
- Complete and transition an initial integrated hydrodynamic/acoustic propagation modeling capability for littoral regions. (NRL)

	FY 2004	FY 2005	FY 2006	FY 2007
National Oceanographic Partnership Program (NOPP)	0	0	9,914	9,898

This activity focuses on U.S. Navy investments in the National Oceanographic Partnership Program (NOPP). NOPP, established by the U.S. Congress (Public Law 104-201) in Fiscal Year 1997, is a unique collaboration among 15 federal agencies involved in conducting, funding, or utilizing results of ocean research. NOPP's value to the Navy derives from the capacity of the partnership to enable and ensure multi-agency efforts where such collaboration enhances efficiency or effectiveness, and/or reduces costs. Major areas of investment by NOPP include: (1) development of an integrated coastal ocean observation system and development of sensors, communications and data acquisition, storage and processing tools required to effect it; (2) modernization of

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ocean research and observation infrastructure; and, (3) marine mammal-related research.
The transition from other activities in the PE resulted in a 100% increase in FY06 and FY07.

FY 2004 Accomplishments:

- Funded in other activities noted in the FY 2006 plans.

FY 2005 Plans:

- Funded in other activities noted in the FY 2006 plans.

FY 2006 Plans:

Efforts noted below transitioned from BSE Concept Enabler.
- Continue marine mammal program on noise mitigation.
- Continue the following NOPP efforts begun in earlier years: Real-Time Forecasting System of Winds, Waves, and Surge in Tropical Cyclones; PARADIGM, GODAE, and HYCOM.
- Complete the following NOPP effort: MOSEAN.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed.

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
BIOLUMINESCENCE TRUTH DATA MANAGEMENT AND SIGNATURE DETECTION	961	990

FY04: This effort funded research into the development of affordable, compact, efficient sensors that allow ease of deployment and permit the rapid measurement of bioluminescence in the world’s oceans in order to create a database for future research.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

FY05: Continue research into the development of affordable, compact, efficient sensors that allow ease of deployment and permit the rapid measurement of bioluminescence in the world's oceans in order to create a database for future research. 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.

	FY 2004	FY 2005
CARBON NANOTUBE-BASED RADIATION HARD NON-VIOLATILE RAM	0	4,457

Effort supports Carbon Nanotube-Based Radiation Hard Non-Violatile RAM.

	FY 2004	FY 2005
CENTER FOR MARITIME SYSTEMS	2,691	0

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

	FY 2004	FY 2005
COASTAL ENVIRONMENTAL EFFECTS	0	4,160

Effort supports Coastal Environmental Effects.

	FY 2004	FY 2005
EXTENDED CAPABILITY UNDERWATER OPTIC IMAGING	2,165	990

FY04: This effort funded the research into development of smaller, more energy efficient sensors for autonomous underwater vehicles with an enhanced ability to detect and identify man-made objects in support of mine and undersea warfare.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

FY05: This effort continues research into development of smaller, more energy efficient sensors for autonomous underwater vehicles with an enhanced ability to detect and identify man-made objects in support of mine and undersea warfare.

	FY 2004	FY 2005
INTEGRATED LITTORAL SENSOR NETWORK	0	990

The central goal of the Integrated Littoral Sensor Network is to integrate scientific resources and understanding so as to enable rapid and effective response to potential terrorist threats as well as to episodic natural or accidental hazards, such as severe storms, harmful algae blooms or toxic spills. Deliverables to the Navy will be a portable suite of sensors, models and informatics techniques for detection, diagnosis, and predictions of manmade and natural water-borne pathogens and toxins in ports, bays and littoral waters.

	FY 2004	FY 2005
OCEANOGRAPHIC SENSORS FOR MCM/AUTONOMOUS MARINE SENSORS	4,493	2,476

FY04: This effort funded research into the development of small, low-power sensors to use on small autonomous underwater vehicles designed for covert characterization of denied areas, thereby giving the Navy a new capability in MCM operations.

FY05: Continue research into the development of small, low-power sensors to use on small autonomous underwater vehicles designed for covert characterization of denied areas, thereby giving the Navy a new capability in MCM operations.

	FY 2004	FY 2005
SOUTH-EAST ATLANTIC COASTAL OCEAN OBSERVING SYSTEM (SEACOOS)	5,765	4,953

FY04: This effort provided funding for SEACOOS which is a regional partnership that integrates the coastal ocean observing system for a four-state region of southeast coastal U.S. (NC, SC, GA, FL). This effort has importance for Homeland Security as well as for Naval oceanography in general.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

FY05: This effort continues funding for SEACOOS. It enhances data access to significantly improve the understanding of atmospheric, oceanic and coupled behaviors in the southeastern U.S., Bahamas, northern Caribbean basin and in the surrounding larger-scale systems.

	FY 2004	FY 2005
SURA COASTAL OCEAN OBSERVATION PROGRAM (SCOOP)	0	2,575

The Southeastern Universities Research Association (SURA) Coastal Ocean Observing Prediction (SCOOP) Program works towards the goal of providing a national system for observing and predicting the myriad events that occur in America's vital coastal waters. The SCOOP proposes to take on the task of integrating diverse systems at the national level. Deliverables are software modules for data transport and data translation, computing storage & services, numerous demonstrations, and program integration.

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

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

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602435N PROGRAM ELEMENT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH
PROJECT TITLE: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

D. ACQUISITION STRATEGY:
Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2a

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602651M
PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS PROGRAM
COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R0000 No Project Assigned	0	1,880	6,000	6,000	6,000	6,000	6,000	6,000

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This new Program Element (PE) continues and realigns funding for a program for the applied research, study, assessment, and demonstration of technologies that could provide a non-lethal capability or target effect. This effort was funded under PE 0602114N, Power Projection Applied Research in FY 2005. Because the Marine Corps serves as the Executive Agent for the Joint Non-Lethal Weapons Program, new program elements were created as part of the FY 2006 budget formulation, to properly reflect this designation. Investment areas include applied research related to: non-lethal directed energy weapons (lasers, millimeter wave and high power microwave) for counter-personnel and counter-material missions; non-lethal acoustic and optical technologies; advanced non-lethal materials (including materials for vehicle/vessel stopping and advanced anti-traction materials); associated human effects and effectiveness for new non-lethal stimuli; injury potential and effectiveness of directed energy, electric stun, ocular, and acoustic based non-lethal technologies; and developing models of crowd behavior and dynamics.

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	0	0	0	0
Program Adjustment	0	1880	6000	6000
FY 2006/2007 President’s Submission	0	1880	6000	6000

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602651M
PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS PROGRAM

ACCOMPLISHMENTS/PLANNED PROGRAM:

FY 2005 Plans:

• Initial effort will perform research to examine non-lethal target effects/characterization of non-lethal acoustic and optical (light stun/distract)
• Research into the formation, optimization, and control of laser induced plasma phenomenon for its non-lethal applications. Laser induced plasma (LIP) is a phenomena of some high energy, short pulse lasers that has several potential applications to produce or transmit non-lethal stimuli. Investigate characteristics and optimization of the LIP phenomena for both counter-personnel and counter-material missions.
• Research, test and evaluate several advanced non-lethal material technologies for advanced non-lethal weapons, such as new anti-traction materials.

FY 2006 Plans:

• Investigate the human effects associated with high-energy counter-material and counter-personnel lasers. It will examine human effects from exposure to counter-material lasers' direct and scattered radiation and laser-induced plasmas from counter-personnel lasers. This research will also examine specific non-lethal effects and effectiveness associated with the laser-induced plasma phenomenon.
• Support further applied research currently being performed under the JNLWD's Non-Lethal Technology Innovation Center (NTIC). The continued mission of the NTIC is to foster the free flow of appropriate Science and Technology (S&T) information between the JNLWD and academia, industry, military, and other government entities.
• Continue research, test and evaluate several advanced non-lethal material technologies for advanced non-lethal weapons, such as new anti-traction materials, engine suffocates, morphing materials for new non-lethal rounds or flight bodies, and new non-lethal nano-materials.

FY 2007 Plans:

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602651M
PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS PROGRAM

• Explore the use of light and sound to confuse, startle, or incapacitate, for periods of a few seconds to minutes at operationally useful ranges. It will also determine injury thresholds. This initiative will also perform applied research on existing acoustic and optical non-lethal weapons, and support analyses to develop possible improvements and enhancements to existing NL Acoustic Weapons (including developing optimum aversive sounds, and developing better flash-bang grenades.
• Investigate the in-vitro and in-vivo bio-effects of intense electromagnetic fields and radio frequency radiation exposures that could result from directed energy non-lethal weapons systems.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
PE 0603851M (Marine Corps Non-Lethal Warfare)

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N
PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
UNDERSEA WARFARE APPLIED RESEARCH	69,923	84,325	71,362	85,857	72,931	74,098	61,962	60,928

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

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

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N
PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	76,788	64,060	63,244	63,797
Cong Rescissions/Adjustments/Undist. Reductions	0	-917	0	0
Congressional Action	0	21,200	0	0
Execution Adjustments	-4,892	0	0	0
FNC Realignment	0	0	-560	891
Non-Pay Inflation Adjustments	-71	0	0	0
Program Adjustments	0	-18	-67	-71
Program Realignment	0	0	8,727	20,893
Rate Adjustments	0	0	18	347
SBIR Assessment	-1,902	0	0	0
FY 2006/2007 President's Budget Submission	69,923	84,325	71,362	85,857

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
UNDERSEA WARFARE APPLIED RESEARCH	69,923	84,325	71,362	85,857	72,931	74,098	61,962	60,928

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

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
WIDE AREA ANTI-SUBMARINE (ASW) SURVEILLANCE	14,232	18,494	27,946	41,558

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-components, multi-static operation, and supported by passive/active signal processing all with the objective of increased detection capabilities.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

FY 2004 Accomplishments:

- Continued development of Telesonar technologies to enable deployable system acoustic communications.
- Continued development of signal processing algorithms aimed at reducing clutter-generated false alerts.
- Continued development/improvement of multi-static signal processing techniques for systems employing coherent sound sources.
- Continued development of “intelligent” algorithms aimed at optimizing distributed multistatic sources/receivers.
- Completed feasibility assessment of using Anti-Submarine Warfare (ASW) acoustic intensity sensors as active receivers.
- Completed development/improvement of multistatic signal processing techniques for systems employing explosive sound sources.
- Completed development of ultra-low power electronics to support advanced ASW maritime remote sensing devices.
- Completed development of deployable volumetric arrays capable of tactically significant gains.
- Completed quantification of potential biologic clutter and false targets for active sonar using fish school size and acoustic intensity data. (NRL)
- Completed determination of channel capacity limits versus data rate for Underwater Acoustic Communications (ACOMMS) systems in specific littoral environments. (NRL)
- Completed initial demonstrations of acoustic time-reversal techniques at sea in a shallow water environment. (NRL)
- Completed analysis of acoustic noise data and determined that the contributions of coastal fishing vessels can have a major impact on the total noise field. (NRL)
- Initiated development of an advanced node design for survivable sensors.
- Initiated development of a non-traditional tracking system for deployment on undersea vehicles.
- Initiated development of multistatic signal processing algorithms with controllable transmit waveform type and ping schedule to enable improved detection and tracking of threat submarines.

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continued development and testing of a series of incremental software builds for in-buoy signal processing.
- Continued development of smaller, cheaper low-frequency active transducers for multistatic sonar systems.
- Completed development of transducer, power source, and power amplifier components for the Compact Deployable Multistatic Source (CDMS).
- Completed development and at-sea testing of Compact Deployable Multistatic Receiver (CDMR) hardware and

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

software.
- Initiated development of “field-level” processing for large numbers of CMDRs.
- Initiated at-sea testing of the multistatic system components (CDMR, signal processing software, and “field-level” processing).

FY 2005 Plans:

- Continue all FY 2004 efforts less those noted as completed.
- Complete analysis of at-sea data to validate signal-processing techniques derived from acoustic time-reversal concepts. (NRL)
- Complete development of high data rate multi-access communications technique in Underwater Acoustic Communications (ACOMMS) and provide a demonstration of its capability. (NRL)
- Initiate integration of a prototype system for undersea persistent surveillance.
- Initiate investigation of undersea persistent surveillance system performance through simulation and subsystem tests.
- Initiate development and testing of components of a prototype system for undersea persistent surveillance.
- Initiate testing of a non-traditional tracking system.
- Initiate efforts to develop an underwater intruder defense system, including comprehensive active and passive signatures from swimmers, harbor environment noise characteristics, and fiber optic array technology. (NRL)

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continue all FY 2004 efforts less those noted as completed.
- Complete development of “field-level” processing for large numbers of Compact Deployable Multistatic Receivers (CMDRs).
- Complete development and testing of a series of incremental software builds for in-buoy signal processing.
- Complete development of smaller, cheaper low-frequency active transducers for multistatic sonar systems.
- Complete Palantir Project Plan.
- Initiate concept feasibility study and initial design concepts for a non-acoustic surveillance system (Palantir).

FY 2006 Plans:

- Continue all FY 2005 efforts less those noted as completed.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

- Complete development of multistatic signal processing algorithms with controllable transmit waveform type and ping schedule to enable improved detection and tracking of threat submarines.
- Complete efforts to measure, quantify, and model reverberation and clutter from biologics and the seafloor and provide a prediction tool for multistatic active sonars. (NRL)
- Initiate planning for testing of advanced node designs and associated technologies.
- Initiate development of alternative active optical sources and sensor devices for Non-Acoustic ASW systems.

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continue all FY 2005 efforts less those noted as completed.
- Complete integrated at-sea testing of the multistatic system components (CDMR, signal processing software, and “field-level” processing).
- Complete concept feasibility study and initial design concepts for a non-acoustic surveillance system (Palantir).
- Initiate design and development of Palantir sensor and data collection system and conduct a FY 2006 data collection exercise.
- Initiate experimental test planning for Palantir sensor.
- Initiate Deployable Autonomous Distributed System (DADS) study of component feasibility to enable effective deployment, survival, and cost options. This effort transitions to Program Element 0603747N in FY 2007.

FY 2007 Plans:

- Continue all FY 2006 efforts less those noted as completed or transitioned.
- Complete development of Telesonar technologies to enable deployable system acoustic communications.
- Complete testing of advanced node design and associated technologies.
- Complete evaluation of undersea persistent surveillance system performance and trade-offs.
- Complete integration of a prototype system for undersea persistent surveillance.
- Complete demonstration of a prototype system for undersea persistent surveillance.
- Complete investigation of undersea persistent surveillance system performance through simulation and subsystem tests.
- Complete development and testing of components of a prototype system for undersea persistent surveillance.
- Complete initial development of an underwater intruder defense system and provide a demonstration of a viable overall system concept. (NRL)
- Complete analysis and modeling of high frequency underwater acoustic communications techniques between Unmanned Undersea Vehicles (UUVs) and demonstrate its capability. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continue all FY 2006 efforts less those noted as completed.
- Initiate an applied research effort to improve distributed system processing techniques and capabilities.
- Initiate the On-Demand Detection Classification and Localization (DCL) effort focusing on the development of sensor and platform designs compatible with notional Concept of Operations (CONOPS).
- Initiate an effort to develop automation techniques for transition to various Littoral ASW distributed sensor systems.

	FY 2004	FY 2005	FY 2006	FY 2007
BATTLEGROUP ANTI-SUBMARINE WARFARE (ASW) DEFENSE	25,125	28,282	23,902	16,872

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 2004 Accomplishments:

- Continued development of Reduced Diameter fiber optic sensors to improve towed array reliability.
- Continued development of sensors and algorithms to compensate for towed array performance degradation during maneuvers/turns.
- Continued development of structural magnetostrictive materials to enable more rugged transducer designs.
- Continued development of signal processing improvements for coherent tactical active sonar systems aimed at improving Detection, Classification, and Localization of small, slow moving submarines in shallow water.
- Continued investigation of synthetic aperture sonar techniques for improving target versus clutter classification performance.
- Continued investigations into time-reversal techniques to improve the performance of active sonar systems.
- Continued development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Continued development and complete testing of line arrays with piezocrystal vector sensors for improved signal-to-noise and bandwidth.
- Continued design and development of underwater projectors using structural magnetostrictive materials.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

- Continued development of baffled ring transducer technology.
- Continued development of improved techniques to distinguish submarine echoes from those produced by ocean bottom features.
- Completed development and evaluation of advanced sonar signal classification algorithms, using “support vector machines”, which enable improved sonar operator performance.
- Completed development and testing of a low-cost fishline fiber optic array for platform-based deployment.
- Completed 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--transitioned to the Advanced Systems Technology Office, SEA-93, and Program Element 0603561N. (Transduction)
- Completed development of very thin, compact High Frequency cymbal transducers for conformal arrays.
- Completed demonstration showing that geo-acoustic inversion using a towed array is insensitive to the source-receiver range. (NRL)
- Initiated development of an acoustic/magnetic hybrid sensor.
- Initiated the development of a concept that automatically guides sonar operators through the complicated, threat submarine detection, classification, and tracking process.

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continued development and demonstration of signal processing algorithms designed to automatically detect and classify acoustic signatures of threat submarines. This work transitioned to Program Element 0603747N in FY 2005.
- Continued characterization of undersea threat signals and clutter to be used to design new signal processing algorithms for submarine and surveillance sonar systems. This work transitioned to Program Element 0603747N in FY 2005.
- Continued passive acoustic array testbed design and hardware component procurement to support future passive sonar system designs.
- Continued development of signal processing and system control algorithms for the AN/WSQ-11 “Tripwire” torpedo protection system.
- Continued development of an AN/WSQ-11 “Tripwire” testbed for the testing of algorithms.
- Completed system requirements definition for the AN/WSQ-11 “Tripwire” system that will protect surface ships from torpedo salvo attacks.
- Completed hardware risk-reduction efforts for the AN/WSQ-11 “Tripwire” to protect surface ships from torpedo salvo attacks.
- Completed development of Lead Zirconate Titanate (PZT) materials for High-Frequency Broadband Transducers &

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

Arrays for submarines.
- Initiated preliminary Multi-Mode Magnetic Detection System design and component-level development of air deployed magnetometer sensor technologies.
- Initiated Multi-Mode Magnetic Detection System development and installation of real-time noise reduction, detection, and tracking algorithms on a simulator to enable data collection and performance evaluation.

FY 2005 Plans:

- Continue all FY 2004 efforts less those noted as completed.
- Complete evaluation of Reduced Diameter fiber-optic sensor to improve towed array reliability and transition to the NAVSEA Advanced Systems Technology Office, Program Element 0603561N.
- Complete development of sensors and algorithms to compensate for towed array performance degradation during maneuvers/turns. Transition to the NAVSEA Advanced Systems Technology Office, Program Element 0603561N.
- Complete investigation of synthetic aperture sonar techniques for improving target versus clutter classification performance.
- Complete investigations into time-reversal techniques to improve the performance of active sonar systems.
- Complete design and development of underwater projectors using structural magnetostrictive materials.
- Complete the development of a concept that automatically guides sonar operators through the complicated, threat submarine detection, classification, and tracking process.
- Complete investigations of the feasibility of geo-acoustic parameter inversion and demonstrate using an operational Navy asset. (NRL)
- Initiate development of low cost, compact, combined acoustic sensor. This effort will contribute to applied research for undersea persistent surveillance.
- Initiate development of advanced sonar signal processing algorithms that integrate target classification and tracking into a combined system for autonomous deployable sensor processing.

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continue all FY 2004 efforts less those noted as completed or transitioned.
- Complete hardware component integration, testing, and installation of an acoustic array test bed in support of future passive sonar system designs.
- Complete preliminary Multi-Mode Magnetic Detection System (MMMDS) design and component-level development of air deployed magnetometer sensor technologies.
- Complete MMMDS development and installation of real-time noise reduction, detection, and tracking algorithms to enable data collection and performance evaluation.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

- Initiate a focused research study to evaluate sonar performance using the acoustic array testbed.
- Initiate collection and analysis of MMMDS performance data. This effort transitions to Program Element 0603747N in FY 2006.
- Initiate evaluation of proposed MMMDS processing approaches and down-select to one approach. This effort transitions to Program Element 0603747N in FY 2006.

FY 2006 Plans:

- Continue all FY 2005 efforts less those noted as completed.
- Complete development of structural magnetostrictive materials to enable more rugged acoustic transducer designs.
- Complete development of baffled ring transducer technology.

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continue all FY 2005 efforts less those noted as completed or transitioned.
- Complete Adaptive Beamforming processing development.

FY 2007 Plans:

- Continue all FY 2006 efforts less those noted as completed.
- Complete development of Acoustic Flux Sensor for affordable improvement of sonar signal-to-noise.
- Complete development of line arrays with piezocrystal vector sensors for improved signal-to-noise and bandwidth.

The following efforts contribute to the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continue all FY 2006 efforts less those noted as completed.
- Complete a focused research study to evaluate sonar array performance using the acoustic array testbed and provide a Transition Report to the Chief of Naval Operations, Director Submarine Warfare Division, Code N77.

	FY 2004	FY 2005	FY 2006	FY 2007
COOPERATIVE ASW	1,149	1,236	749	752

Cooperative ASW technology developments enable ASW platforms to work together effectively to detect, classify, and localize very quiet undersea targets. Many of the tools required to achieve this objective were being

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE APPLIED RESEARCH
PROJECT TITLE: UNDERSEA WARFARE APPLIED RESEARCH

developed as components of the Littoral Anti-Submarine Warfare (LASW) Future Naval Capability under the heading of Integrated Anti-Submarine Warfare (IASW) in Program Elements (PEs) 0602235N and 0603235N. A portion of those efforts continued in this PE (0602747N) as Cooperative ASW in FY 2004. The focus of this effort was to leverage those concepts and technologies previously investigated under IASW in order to develop technologies that enabled the exchange and fusion of ASW sensor data among the technologies developed under Battlgroup ASW Defense, Wide Area ASW Surveillance, and Neutralization program areas.

FY 2004 Accomplishments:

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

FY 2005 Plans:

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

FY 2006 Plans:

- Continue development of technologies to automatically fuse tactical ASW sensor information to enhance the ASW portion of the Common Tactical Undersea Picture.

FY 2007 Plans:

- Complete development of technologies to automatically fuse tactical ASW sensor information to enhance the ASW portion of the Common Tactical Undersea Picture.

	FY 2004	FY 2005	FY 2006	FY 2007
NEUTRALIZATION	14,807	15,314	18,765	26,675

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Neutralization focuses on technologies for undersea weapons to counter threat submarines by increasing the Probability of Kill (Pk). Weapon technology focus areas include: Counterweapons/Countermeasures (CW/CM), Explosives and Warheads, Guidance and Control (G&C), Multidisciplinary Systems Design & Optimization (MSDO) (comprising Simulation Based Design, Silencing and Propulsion), Power Sources, Supercavitation, and Demonstration of Torpedo Bridging Technologies (TBT). The ultimate goal is to develop reduced sized advanced undersea weapons with revolutionary capabilities to fill Sea Shield Warfighter Capability Gap/Enabling Capability: Rapid Submarine Cueing, Detection, Localization, and Neutralization in Shallow and Deep Water/LASW Gap 1: Provide improved submarine cueing/wide area search in deep and shallow water ocean areas. Capability must include ability to rapidly transition to submarine neutralization/engagement.

FY 2004 Accomplishments:

- Continued development of improved threat models and torpedo system simulation capabilities under the Torpedo Enterprise Advanced Modeling and Simulation (TEAMS) initiative.
- Continued development of technologies for terminal defense against close-in waterborne/underwater threats and high-speed weapons (examine experimentally, in water, the physics of interactions among multiple supercavitating projectiles in a projectile burst).
- Continued development of the Low Acoustic Signature Motor/Propulsor for Electronically Powered (LAMPrEy) undersea vehicle to further enhance Torpedo Stealth efforts.
- Continued optimization of undersea weapons system design using MSDO with respect to construction and performance.
- Continued to develop enhanced performance directed energy torpedo warhead technologies for Light-Weight Torpedo (LWT) Improvement and Compact Rapid Attack Weapon (CRAW) applications.
- Continued validation of computational models for torpedo lethality.
- Completed development of weapon noise models and control concepts for propulsor radiated noise.
- Completed fabrication and tested supercavitation homing sensor using single crystal and piezoelectric and piezoceramic materials.
- Completed transition of Integrated Simulation Based Design Environment (ISBDE) to Canistered Countermeasure Anti-Torpedo (CCAT) vehicle.
- Initiated application of MSDO tools probabilistic methods and uncertainty analysis for LWT design.
- Initiated development of algorithms for coordinated behavior of groups of torpedo defense vehicles.
- Initiated development of supercavitation controller and autopilot, and integration with control surfaces and devices.

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- Initiated effort to conduct full ship validation effort for Explosion Response simulation code, using Dynamic System Mechanics Advanced Simulation (DYSMAS) Hydrocode (test plan developed, finite element ship model was completed, pretest simulations were conducted).
- Initiated implementation of MSDO tools in hybrid propulsion and Weapons Silencing systems development.

The following efforts support the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continued development of TBT Weapons G&C innovative adaptive broadband signal processing algorithms that will improve a torpedo’s single-ping detection, classification and localization.
- Continued development of TBT for weapons and combat systems to capitalize on connectivity between a Heavy-Weight Torpedo (HWT) and submarine platform combat control including sensors.
- Completed collection and transition of in-water broadband weapon sonar data sets to the Mk48 and Mk54 programs.
- Completed and transitioned Narrow Band Intelligent Controller technology source code, development tools, documentation, and performance assessments to the Mk 48 Common Broadband Advanced Sonar System (CBASS) program via the torpedo Advanced Processor Build (APB) process.
- Completed and transitioned Frequency Agile Adaptive Beamforming algorithms to the Mk 48 program via the torpedo APB process.
- Initiated and completed studies to determine specifications for new, broadband sonar for the MK54 lightweight torpedo.
- Initiated TBT high fidelity simulation based evaluation of weapon signal processing and HWT tactical control technologies.
- Initiated planning of a joint project agreement between the US and UK titled “Torpedo Guidance and Control (G&C): False Targets" and delivered a summary statement of intent (SSOI) to the Navy International Project Office (NIPO).

FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed.
- Complete development and in-water testing of the Weapon Silencing integrated motor/propulsor - LAMPrEy.
- Complete development of a high fidelity Simulation Based Design (SBD) evaluation of weapon signal processing and HWT tactical control technologies.
- Complete development of TBT Weapons G&C innovative adaptive broadband signal processing algorithms that will improve a torpedo’s single-ping detection, classification, and localization.
- Initiate development of a supercavitating 6.75-inch (or full-scale) vehicle with vehicle control devices and

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homing sensors.

The following efforts support the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continue all efforts of FY2004 less those noted as completed.
- Complete development and in-water demonstration of technologies to enable a HWT and a shooting platform to be effectively employed as a fully linked broadband weapon system.
- Complete validation of a high fidelity weapon simulation false alarm bottom model.
- Initiate TBT LWT broadband data collection.
- Initiate feasibility assessment and investigation of TBT including coherent broadband sonar design, novel adjunct sensors, warhead advancements, and distributed sensor interoperability for LWT.

FY 2006 Plans:

- Continue all efforts of FY2005 less those noted as completed.
- Complete transition of undersea weapons system design tools techniques to LWT, Anti-Torpedo Torpedo (ATT), and Next Generation Coumtermeasure (NGCM).
- Complete full ship validation effort for Explosion Response simulation code, conduct analysis of test data, and continue upgrades to DYSMAS Hydrocode including technologies to increase computational speed.

The following efforts support the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continue all efforts of FY2005 less those noted as completed.
- Initiate TBT sensor package development to achieve integrated coherent broadband sonar and novel adjunct sensors homing and classification capabilities for LWT.
- Initiate TBT development of an advanced LWT directed charge warhead, multi-mode fusing, and sub-scale detonation testing.
- Initiate TBT advanced counter-countermeasure algorithm and tactics development for LWT.
- Initiate feasibility assessment of TBT to best utilize precision targeting and distributed sensors for weapon employment from high altitude and standoff range.

FY 2007 Plans:

- Continue all efforts of FY2006 less those noted as completed.
- Complete development of torpedo system simulation capabilities under TEAMS.

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The following efforts support the Littoral Anti-Submarine Warfare Future Naval Capability:
- Continue all efforts of FY2006 less those noted as completed.
- Complete the joint project agreement between the US and UK titled “Torpedo Guidance & Control (G&C): False Targets" and investigate options for continued collaboration.
- Initiate development of a reduced size/weight CRAW) for air deployment. This effort will include sensor, guidance and control, warhead, propulsion, and air frame integration tasks.

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
ACOUSTIC GLIDER	0	4,259

Design, build, and test a prototype acoustic glider capable of operation in harsh littoral environments.

	FY 2004	FY 2005
AN/SQS-53C MINE DETECTION AND CLASSIFICATION ENHANCEMENTS	1,636	0

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

	FY 2004	FY 2005
ANTI-TORPEDO TORPEDO (6.75-INCH DIAMETER) MULTI-MISSION UNDERSEA WEAPON	2,450	5,052

FY 2004: Initiated optimization of signal processing and 6.75” weapon tactics used in Anti-Torpedo Torpedo (ATT) for offensive applications; updated the multi-mission ATT performance assessment software tools to address air dropped compact rapid attack weapon concept; and collected in-water data to evaluate proposed multi-mission guidance and control technologies. Demonstrated, using simulation and in-water investigation, the ability of the 6.75” sensor to accomplish directed charge placement normal to a submarine target.

FY 2005: Continue most promising efforts of FY 2004. Expand the optimization and demonstration of the effectiveness of a 6.75" sensor to effectively place a directed charge on a submarine target.

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	FY 2004	FY 2005
GALFENOL ALLOYS	0	1,188

Initiate development of metallurgical techniques to inexpensively manufacture Galfenol and other compositions of that general class of magnetostrictive materials. Galfenol is ductile (i.e., not brittle) and as such can be utilized in numerous applications that normal magnetostrictive and piezoelectric materials cannot be used.

	FY 2004	FY 2005
HIGH POWERED ULTRASONICS/ SHIP WASTE TREATMENT	1,443	990

FY 2004: Initiated feasibility and efficacy studies using terfenol magnetostrictive materials for several Navy environmental waste treatment applications. Initiate examination of a variety of shipboard wastes and waste treatment processes to determine the potential for developing new approaches to Navy waste treatment or improvements in performance of existing waste treatment systems using high-powered sonication technologies.

FY 2005: Continue most promising efforts of FY04. Initiate development of a small-scale prototype system for treating shipboard waste using high-powered ultrasonic technology.

	FY 2004	FY 2005
LITHIUM CARBON MONOFLUORIDE BATTERY	962	0

Developed proof-of-concept AA wound cells with thin electrodes. Defined the optimal cell design to be incorporated into future D and DD size cells for Navy buoy applications. Conducted investigation of density, pellet thickness, electrolyte absorption, and cathode swelling properties as related to discharge performance. Developed model to predict cathode behavior during discharge. Conducted feasibility study of various cathode technologies.

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	FY 2004	FY 2005
LOW ACOUSTIC SIGNATURE MOTOR/PROPULSOR	1,698	0

Fabricated and integrated modified component hardware into water tunnel test vehicle. Instrumented water tunnel test vehicle to measure propulsor shaft speed, motor operating conditions, and vibration of the propulsor and vehicle hull. Collected and analyzed water tunnel test data on motor performance and acoustics. Completed integration of modified hardware into at-sea test vehicle and perform Tow Tank testing and At-Sea vehicle runs.

	FY 2004	FY 2005
MAGNETORESTRICTIVE TRANSDUCTION RESEARCH	3,031	3,962

FY 2004: This effort included the investigation and development of iron gallium alloys to determine their magnetostriction and mechanical strength, investigation of cost reduction methods for the production of TERFENOL-D magnetostrictive alloys, and development of transducer design incorporating iron gallium alloys.

FY 2005: Continue the development and transition of Terfenol-D as an active magnetostrictive material for use in advanced underwater sonar transducer arrays. This effort will be expanded to include improvements to the corrosion resistance of the material.

	FY 2004	FY 2005
MEMS-IMU	3,390	2,774

FY 2004 and FY 2005: Initiate development of advanced manufacturing processes for Microelectromechanical Systems (MEMS) and demonstrate their reliability and application in system prototyping and low volume output for various applications. The initial demonstration was focused on the Navy's Containerized Countermeasure Anti-torpedo Torpedo (CCAT) Inertial Measurement Unit (IMU) integrated into the MEMS safe and arm system. Enabling packaging technologies developed in this project will also support future miniature fuze devices. Various sensor sub-continents and integration issues were evaluated for potential applications in remote sensing, munitions health monitoring, and inventory tracking.

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	FY 2004	FY 2005
MICRO-DETONICS FOR MINIATURE WEAPONS	0	2,774

Initiate development of the technology to enable fabrication of integrated Microelectromechanical Systems (MEMS) fuzing and micro-explosive initiators. Base materials and processes for in-situ fabrication of the micro-explosive material will be investigated and developed. Micro-explosive materials resulting from candidate processing methods will be analyzed and tested. The best processes will be adopted and integrated into the MEMS fabrication sequence. The fabrication process, including the incorporation of micro-explosive material into a MEMS Fuzing/Safe & Arming chip, will be demonstrated.

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)
PE 0604784N (Distributed Surveillance Systems)

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

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D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N
PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH	43,637	47,544	49,520	54,839	50,321	51,640	51,166	51,843

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Provides technologies for Naval Mine Countermeasures (MCM), U.S. Naval sea mines, Naval Special Warfare (NSW), and Department of Defense (DOD) Explosive Ordnance Disposal (EOD). It is strongly aligned with the Joint Chiefs of Staff Joint Warfighting Capability Objectives through the development of technologies to achieve military objectives with minimal casualties and collateral damage. Within the Naval Transformation Roadmap, this investment will achieve one of three “key transformational capabilities” required by “Sea Shield” as well as technically enable the Ship to Objective Maneuver (STOM) key transformational capability within “Sea Strike” by focusing on technologies that will provide the Naval Force with the capability to dominate the battlespace, project power from the sea, and support forces ashore with particular emphasis on rapid MCM operations. These efforts concentrate on the development and transition of technologies for the Organic Mine Countermeasures (OMCM) and Littoral Combat/Power Projection (LC/PP) Future Naval Capabilities (FNCs). The Mine and Obstacle Detection/Neutralization efforts include technologies for clandestine minefield surveillance and reconnaissance, organic ship self-protection, organic minehunting and neutralization/breaching. Littoral Combat Warfare effort includes critical warfighting functions such as Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnsissance (C4ISR), fires, maneuver, sustainment, etc. The NSW and EOD technology efforts concentrate on the development of technologies for near-shore mine/obstacle detection and clearance, mobility and survivability, as well as EOD.

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

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PROGRAM ELEMENT: 0602782N
PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	47,929	48,016	47,176	49,777
Cong Rescissions/Adjustments/Undist. Reductions	0	-462	0	0
Execution Adjustments	-3,070	0	0	0
FNC Realignment	0	0	1,736	3,098
Non-Pay Inflation Adjustments	-44	0	0	0
Program Adjustments	0	-10	633	1,778
Rate Adjustments	0	0	-25	186
SBIR Assessment	-1,178	0	0	0
FY 2006/2007 President's Budget Submission	43,637	47,544	49,520	54,839

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

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PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
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COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH	43,637	47,544	49,520	54,839	50,321	51,640	51,166	51,843

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project focuses on reducing the time involved in conducting Mine Countermeasures (MCM) operations and removing personnel from minefields. The MCM project develops and transitions technologies for Organic Mine Countermeasures and Littoral Combat/Power Projection Future Naval Capabilities (OMCM and LC/PP FNCs). These include technologies for clandestine minefield surveillance and reconnaissance, organic ship self-protection, organic minehunting, neutralization/breaching and clearance. The Littoral Warfare effort includes critical warfighting functions such as Command, Control, Communication, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), fires, maneuver, sustainment, etc. The sea mining effort emphasizes technologies for future sea mines. The Naval Special Warfare and Explosive Ordnance technology efforts concentrate on the development of technologies for near-shore mine/obstacle detection and clearance, mobility and survivability, as well as Explosive Ordnance Disposal (EOD).

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
LITTORAL COMBAT	112	2,162	485	1,853

Within the Naval Transformation Roadmap, this investment supports achievement of transformational capabilities of Ship to Objective Maneuver, a key transformational capability within Sea Strike. Activity develops and demonstrates prototype capability to enable Naval Expeditionary Forces to influence operations ashore. The goal of Littoral Combat is the application of technologies to enhance the ability of the Navy/Marine Corps team to execute the naval portion of a joint campaign in the littorals. This activity considers all the critical functions of warfighting: Command, Control, Communication, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), fires, maneuver, sustainment, force protection, and training.

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This activity, which reflects LC/PP FNC investments formerly included in Mine/Obstacle Detection, was split out to provide improved detail of the underlying investment.

FY 2004 Accomplishments:

-Continued integration, development and demonstration of secure mobile networks/secure wireless local area network (LAN) and Beyond Line of Sight (BLOS) communication technologies. (FY 05 effort funded by PE 0602131M).

FY 2005 Plans:

-Continue development of advanced sensing algorithms to derive maps using digital imagery from airborne ISR assets to support expeditionary maneuver. (Previous efforts funded by PE 0602131M; FY 06 effort funded by PE 0602131M)
-Continue development of advanced weapon materials technologies. (Previous efforts funded by PE 0602131M and PE 0602236N; FY 06 effort funded by PE 0602131M)
-Continue development of expeditionary warfare decision support tools for Marine ground forces to support of ship to objective maneuver (STOM). (FY 06 effort funded by PE 0602131M)
-Initiate development of an advanced sensor miniature digital data link. (Concurrent effort PE 0603782N)
-Initiate development of organic light emitting diode (OLED) display technology for shipboard use.

FY 2006 Plans:

-Continue design and development of rocket propelled grenade (RPG) defensive systems. (Previous efforts funded by PE 0602131M)
-Complete development of organic light emitting diode (OLED) display technology for shipboard use.

FY 2007 Plans:

-Continue design and development of rocket propelled grenade (RPG) defensive systems.
-Continue integration, development and demonstration of secure mobile networks/secure wireless LAN and Position Location Indication communication technologies. (Previous efforts funded by PE 0602236)
-Initiate development of improvised explosive device (IED) detection and neutralization technologies.

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	FY 2004	FY 2005	FY 2006	FY 2007
MINE/OBSTACLE DETECTION	23,153	27,300	30,786	34,916

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

FY 2004 Accomplishments:

-Completed development of Bottom Object Search Sonar (BOSS) disc prototype sensor for 3-D classification of buried mines.
-Completed development of BOSS Synthetic Aperture Sonar(SAS)wing prototype for Unmanned Underwater Vehicle (UUV) applications and conducted at-sea measurements of prototype sensor.
-Completed documentation of Remote Sensing Tier III algorithm development efforts.
-Continued development of prototype broadband acoustic scattering sonar and Post Mission Analysis (PMA) tools.
-Continued development of automated broadband physics-based target recognition algorithms.
-Continued development of motion compensation and beam-forming techniques for long range SAS imaging, focusing on multi-path, shallow water environments.
-Continued development of the Laser Scalar Gradiometer (LSG) for buried mine detection.
-Continued development of the Real-time Tracking Gradiometer (RTG) for Unmanned Underwater Vehicle (UUV) applications.
-Continued development of sensor systems for crawling vehicles, focusing on Surf Zone (SZ) mine detection and identification.
–Continued development of 12.75” UUV technology and the development of common control language for AUVs.
-Continued development Rapid Overt Airborne Reconnaissance (ROAR) active/passive electro-optic image processing for detection of mines/minefields in Very Shallow Water (VSW),
surf Zone (SZ), and the Beach Zone (BZ).
-Continued development of a Surf Zone Index (SZI) to predict sensor performance for both active and passive airborne E-O systems.
-Demonstrated, at-sea, AUV based data collection of broadband acoustic scattering from mines, focusing on

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multi-aspect data collection.
-Initiated development of active electromagnetic sensing for the short-range mine classification.
-Initiated the development of a directional transponder and the development of an acoustic smart marker/pinger for reacquisition of vsw mines.
-Initiated buried and proud mine target scattering measurements in the presence of bottom ripples using parametric and conventional sonar.
-Initiated development of multi-static techniques for multiple, cooperating AUVs.
-Initiated optimization of the data input-output capabilities of the mine burial expert system and began assessment of operational utility during fleet exercises.
–Initiated development of multi-platform fusion of AV-15 Kingfisher contact data via registration with those from the Mine warfare Environmental and Decisions Aids Library (MEDAL) for improved mine detection and avoidance.

Following are D&I efforts:
-Completed development of a comprehensive database of acoustic scattering from mines and false targets. (NRL)
-Completed an at-sea demonstration of the use of time reversal acoustics to scan along the sea bottom using broadband signals for objects. (NRL)
-Completed at-sea demonstration of AUV based SAS for shallow water mine hunting during Combined Joint Task Force Exercise (CFTFEX 04-02).
-Completed development of optical performance models for EO mine identification sensors.
-Continued the development of mine burial sub-models to provide predictions in an acceptable operational format.
-Continued the development of underwater sensor prediction tools to support development, system design, and Tactical Digital Aids efforts.
-Continued development of blazed array obstacle avoidance sonar for AUV applications.
-Initiated development of advanced, prototype Remote Sensing EO sensors for Tactical UAV(TUAV) applications.
-Initiated development of multi-static acoustic sensing and processing for cooperating, unmanned vehicles.

FY 2005 Plans:

-Complete development of prototype broadband acoustic scattering sonar and integration onto a 21 inch AUV.
-Complete development of sas motion compensation and beamforming algorithm for long-range, multi-path environment.
-Complete development of the RTG for classification of buried mines.

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-Complete integration of RTG and BOSS prototype wing onto a 12.75" UUV and executed initial at-sea testing of combined sensors.
-Complete development of the LSG.
-Complete development of blazed array obstacle avoidance sonar and integrate onto a UUV for testing.
-Complete development of a SZI to predict sensor performance for both active and passive airborne EO systems.
-Complete development of multi-platform fusion of AV-15 Kingfisher contact data via registration with those from the Mine Warfare Environmental Decision Aids Library (MEDAL) for improved mine detection and avoidance.
-Continue development of automated broadband physics-based target recognition algorithms.
-Continue the development of active electromagnetic sensing for short-range mine classification.
-Continue buried and proud mine target acoustic scattering measurements in the presence of bottom roughness using parametric and conventional sonars.
-Continue development of sensor systems for crawling vehicles, focusing on SZ mine detection and identification.
-Continue development of multi-static AUV-based minehunting integrating navigation, communication and sensor elements.
–Continue development of 12.75" UUV technology conducting field testing.
-Continue development of a directional transponder and the development of an acoustic smart marker/pinger for reacquisition of VSW mines.
-Continue development ROAR active/passive EO image processing for detection of mines/minefields in VSW, SZ, and the BZ.
-Continue to optimize the data input-output capabilities of the mine burial expert system and participate in a fleet exercise to demonstrate operational utility.
-Initiate at-sea testing of prototype broadband acoustic scattering sonar focusing on multi-aspect mine classification/identification and characterization of clutter in various environments.
-Initiate the development of a low-cost, 12.75" UUV-based EO sensor for mine identification.
-Initiate development of long range, forward-looking sonar for small (12.75") UUVs.
-Initiate data fusion from underwater magnetic and acoustic sensors to enhance Probability of classification (Pc) and reduce false alarm rate for buried mine hunting.
-Initiate testing and evaluation of a common control language for AUVs.
-Initiate development of Over the Horizon (OTH) deployment concepts for UUVs.
-Initiate development of multi-platform fusion of data from high-resolution mine hunting systems (e.g. AN/AQS-20 and submarine-launched Mine warfare (MIW) UUVs via registration with those from the MEDAL for improved mine detection and avoidance.

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Following are D&I efforts:
-Complete analysis and reporting of scanning focused acoustic fields using time-reversal acoustics. (NRL)
-Complete an at-sea demonstration of Broadband SAS detection/classification of buried and proud mines at Sediment Acoustics Experiment 2004 (SAX04).
-Complete the development of underwater sensor prediction tools to support development, system design, and Tactical Decision Aids (TDA) efforts.
-Continue prototype Remote Sensing EO sensors for TUAV applications.
-Continue the development of multi-static acoustic sensing and processing for cooperating, unmanned vehicles.
-Initiate development of a concept of operations for generating geotechnical data inputs to the impact mine burial prediction model. (NRL)
-Initiate evaluation of algorithm development requirements and capitalize on data streams available from national and organic sensors.
-Initiate the primary sub-system design efforts to extend mine identification using acoustic color concept to longer ranges. (NRL)
-Initiate design and development of broadband interferometric SAS.
-Initiate investigations to expand the knowledge of elevated Synthetic Aperture Radar (SAR) imaging algorithms for detecting buried mines. (NRL)

FY 2006 Plans:

-Complete, at-sea, UUV based testing of blazed array obstacle sonar.
-Complete at-sea testing of the RTG and BOSS wing prototype on a 12.75” UUV.
-Complete buried and proud mine acoustic scattering measurements in the presence of bottom roughness using conventional and parametric sonars.
-Complete development of sensor systems for crawling vehicles, focusing on SZ mine detection and identification.
–Complete development and field testing of 12.75” UUV technology.
-Complete testing and evaluation of a common control language for AUVs.
-Complete development of a directional transponder and the development of an acoustic smart marker/pinger for reacquisition of VSW mines.
-Complete development ROAR active/passive electro-optic image processing for detection of mines/minefields in VSW, SZ, and the BZ.
-Continue at-sea testing of prototype broadband acoustic scattering sonar focusing on multi-aspect mine classification/identification and characterization of clutter in various environments.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

-Continue development of automated broadband, physics-based target recognition algorithms utilizing data collected by prototype sonar.
-Continue development of long range, forward-looking sonar for small (12.75”) UUVs.
-Continue the development of a low cost, UUV based electro-optic sensor for mine identification.
-Continue the development of active electromagnetic sensing for short-range mine classification.
-Continue the development of algorithms for the fusion of acoustic, passive electromagnetic, active electromagnetic, and electro-optic classification/identification data.
-Continue development of OTH deployment concepts for UUVs.
-Continue development of multi-static AUV-based minehunting integrating navigation, communication and sensor elements.
-Continue development of tactics for autonomous reconnaissance and mine hunting by multiple cooperating UUVs.
-Continue to optimize the data input-output capabilities of the mine burial expert system and participate in a fleet exercise to demonstrate the utility of the mine burial expert system.
–Continue development of multi-platform fusion of data from high-resolution mine hunting systems (e.g. AN/AQS-20 and sub-launched MIW UUVs via registration with those from MEDAL for improved mine detection and avoidance.
-Initiate development of automatic mine detection and classification algorithms for integrated forward-looking and side-looking sonars.

Following are D&I efforts:
-Complete development and testing of the Integrated Mine Burial Model and transition to the Naval Oceanographic Office (NAVOCEANO). (NRL)
-Complete development of prototype Remote Sensing EO sensors for TUAV applications.
-Continue evaluation of remote sensing algorithm development requirements and capitalize on data streams available from national and organic sensors.
-Continue development of a long-range mine identification system using acoustic color concept. (NRL)
-Continue development of a broadband interferometric SAS.
-Continue to develop mine burial prediction sub-models to support development of the mine burial expert system.
-Continue the development of multi-static acoustic sensing and processing, conducting at-sea exercise involving multiple UUVs.
-Continue design, development and fabrication of elevated SAR breadboard experimental system for mine detection and suitable for eventual UAV applications. (NRL)
-Initiate analysis of at-sea experimental results and sediment poro-elastic and elastic propagation models to investigate the high frequency acoustic bottom interaction for various seafloor sediment properties. (NRL)

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

FY 2007 Plans:

-Complete development of automated broadband, physics-based target recognition algorithms utilizing data collected by prototype sonar; and begin transition to PMS-403 and PMS-495.
-Complete development of long-range, forward-looking sonar for small (12.75”) UUVs and begin at-sea testing.
-Complete the development of active electromagnetic sensor for short range mine classification.
-Complete the development of algorithms for the fusion of acoustic, passive electromagnetic, active electromagnetic, and electro-optic classification/identification data.
-Complete the development of a low cost, UUV based electro-optic sensor for mine identification, integrate onto a UUV, and conduct initial at-sea tests of sensor performance.
-Complete mine burial expert system and transition to the NAVOCEANO.
-Continue at-sea testing of prototype broadband acoustic scattering sonar focusing on multi-aspect mine classification/identification and characterization of clutter in various environments.
-Continue development of OTH deployment concepts for UUVs.
-Continue development of multi-static AUV-based minehunting integrating navigation, communication and sensor elements.
-Continue development of tactics for autonomous reconnaissance and mine hunting by multiple cooperating UUVs.
-Continue development of automatic mine detection and classification algorithms for integrated forward-looking and side-looking sonars.
–Continue development of multi-platform fusion of data from high-resolution mine hunting systems (e.g. AN/AQS-20 and sub-launched MIW UUVs via registration with those from MEDAL for improved mine detection and avoidance.
-Initiate large area search and survey based upon multiple, cooperating UUVs.

Following are D&I efforts:
-Complete development of broadband interferometric SAS and begin at-sea testing.
-Complete evaluation of sediment poro-elastic and elastic propagation models to understand high-frequency acoustic-bottom interactions. (NRL)
-Complete evaluation of remote sensing algorithm development requirements and capitalize on data streams available from national and organic sensors.
-Continue the development of multi-static acoustic sensing and processing, conducting at-sea exercise involving multiple, uuv's.
-Continue conducting tests of elevated SAR breadboard experimental system (NRL).

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

-Continue development of a long-range mine identification system using the acoustic color concept and provide an initial at-sea demonstration. (NRL)

	FY 2004	FY 2005	FY 2006	FY 2007
SPECIAL WARFARE/EOD	9,015	12,140	12,058	12,455

Increase in funding from FY 2004 to FY 2005 is due to NRL efforts in this activity starting in FY 2005. Naval Special Warfare (NSW) missions primarily support covert near-shore naval operations. The goal is to develop technology to increase the combat range and effectiveness of Special Warfare units. A major focus is to develop technologies to enhance the Sea-Air-Land mission of pre-invasion detection for clearance/avoidance of mines and obstacles in the VSW and SZ amphibious landing areas. EOD operations typically occur in shallow, poor-visibility water, with high background noise, and in areas contaminated by a variety of unexploded ordnance (UXO). Advanced technologies are needed to gain access to areas contaminated by area-denial sensors and/or booby traps. These technologies will transition to the Joint Service EOD Program, the Naval EOD Program, or the DOD Technical Response Group. This activity includes applied research in sensor technology for NSW and EOD autonomous and handheld sonar systems to increase detection range and accuracy in harsh environments. Other efforts include mission support technology improvements for AUVs and human divers – such as communications, navigation and life support.

FY 2004 Accomplishments:

-Completed development of digital beamformer architecture for high frequency imaging sonar.
-Completed the characterization of acousto-optic effect in liquid-crystal cells as a function of the key parameters affecting the performance of an underwater imaging device. (NRL)
-Completed development of hyperspectral polarimeter prototype.
-Completed development of scannerless range imaging sensor.
-Completed extended lifetime underwater adhesive development.
-Completed development of passively controlled rebreather.
-Completed study of design alternatives for next generation Swimmer Delivery Vehicle (SDV).
-Continued development of Low Probability of Intercept (LPI)/Low Probability of Detection (LPD) underwater communications.
-Continued development of AUV technologies for autonomous inspection of ship hulls.
-Continued development of standoff detection and classification sensor for surface and buried UXO using multi-dimensional Electro-Magnetic(EM) methods.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

-Continued development of technology to detect, monitor, and disrupt operation of Explosive Safe and Arming (ESA) devices.
-Continued efforts to support the design of a deformable fin for AUV propulsion with 3-D unsteady flow computations of fin flapping. (NRL)
-Continued development of a miniature CO2 sensor.
-Continued development of robotic manipulators, actuators and control algorithms based on artificial muscle materials.
-Initiated development of dual-mode visible sensor for clandestine tracking of near-shore craft and other objects.
-Initiated development of a diver heating system for SDV.
-Initiated development of a composite garment to provide diver thermal insulation.
-Initiated development of man-portable impulse radar system for sense-thru-the-wall applications.

FY 2005 Plans:

-Continue development of dual-mode visible sensor for clandestine tracking of near-shore craft and other objects.
-Continue development of standoff detection and classification sensors for surface and buried UXO using multi-dimensional EM methods.
-Continue development of technology to detect, monitor, and disrupt operation of ESA devices.
-Continue development of LPI/LPD underwater communications.
-Continue development of AUV technologies for autonomous inspection of ship hulls.
-Continue efforts in the design of a prototype deformable fin for AUVs. (NRL)
-Continue development of robotic manipulators, actuators and control algorithms based on artificial muscle materials.
-Continue development of a diver heating system for SDV.
-Complete development of CO2 sensor.
-Complete development of a composite garment to provide diver insulation.
-Complete development of man-portable impulse radar system for sense-thru-the-wall applications.
-Initiate assembly of a prototype portable liquid crystal underwater imager by integrating the liquid-crystal cells with an acoustic lens. (NRL)
-Initiate analysis of NSW equipment signatures.
-Initiate development of an SDV low-observable periscope.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

FY 2006 Plans:

-Complete prototype device of a portable liquid crystal underwater imager and perform a prototype demonstration. (NRL)
-Complete analysis of NSW equipment signatures.
-Complete development of standoff detection and classification sensors for surface and buried UXO using multi-dimensional EM methods.
-Continue development of dual-mode sensor for clandestine tracking of near-shore craft and other objects.
-Continue development of LPI/LPD underwater communications.
-Continue development of AUV technologies for autonomous inspection of ship hulls.
-Continue efforts in the design and optimization of a prototype deformable fin for AUVs. (NRL)
-Continue development of technology to detect, monitor, and disrupt operation of ESA devices.
-Continue development of robotic manipulators, actuators and control algorithms based on artificial muscle materials.
-Continue development of a diver heating system for SDV.
-Continue development of an SDV low-observable periscope.
-Initiate development of buried ordnance identification sensor.

FY 2007 Plans:

-Complete prototype of an AUV using a deformable fin by performing self-propulsion tests on a working vehicle and provide a demonstration. (NRL)
-Complete development of a diver heating system for SDV.
-Continue development of dual-mode visible sensor for clandestine tracking of near-shore craft and other objects.
-Continue development of buried ordnance identification sensor.
-Continue development of LPI/LPD underwater communications.
-Continue development of AUV technologies for autonomous inspection of ship hulls.
-Continue development of SDV low-observable periscope.
-Continue development of technology to detect, monitor, and disrupt operation of ESA devices.
-Continue development of robotic manipulators, actuators and control algorithms based on artificial muscle materials.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

	FY 2004	FY 2005	FY 2006	FY 2007
MINE/OBSTACLE NEUTRALIZATION	4,609	5,744	5,991	5,414

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

FY 2004 Accomplishments:

-Continued development of the mine vulnerability database for kinetic damage, shock, blast and thermal effects.
-Continued development of computational tools and engineering level models to assess dart dispenser concepts.
-Continued development of mine vulnerability database for SZ mines neutralized by pressure and impulse.
-Continued development of advanced computational model to simulate guided bombs in the BZ and SZ against mines and obstacles.
-Initiated assessment of mine jamming utilizing the advanced degaussing system of the San Antonio Class Amphibious Transport Dock Ship(LPD-17).
-Initiated investigation of mine jamming effect on dumb mines.
-Initiated development of platform concepts for autonomous mine neutralization by AUVs.

FY 2005 Plans:

-Complete development of mine vulnerability database for SZ mines neutralized by pressure and impulse.
-Complete development of an advanced computational model to simulate guided bombs against SZ and BZ mines.
-Complete investigation of mine jamming effect on dumb mines.
-Continue development of the mine vulnerability database for kinetic damage, shock, blast and thermal effects.
-Continue assessment of mine jamming using the advanced degaussing system of the LPD-17.
-Continue development of platform concepts for autonomous mine neutralization by AUVs.
-Continue assessment of dart dispenser concepts using advanced computational tools and engineering level models.
-Initiate development of models to assess performance of bombs against mines in Very Shallow Water (VSW).
-Initiate development of advanced computational models for high speed water entry and penetration.

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

-Initiate development of advanced computational tools for predicting soil penetration by countermine darts.
-Initiate assessment of mine jamming using Impressed Current Cathodic Protection (ICCP) system.

FY 2006 Plans:

-Continue development of platform concepts for autonomous mine neutralization by AUVs.
-Continue assessment of dart dispenser concepts using advanced computational tools and engineering level models.
-Continue development of mine vulnerability database for kinetic damage, shock, blast and thermal effects.
-Continue development of models to assess performance of bombs against mines in VSW.
-Continue development of advanced computational models for high speed water entry and penetration.
-Continue development of advanced computational tools for predicting soil penetration by countermine darts.
-Continue assessment of mine jamming using ICCP system.
-Initiate development of tool to assess mine jamming effectiveness on future ship designs.

FY 2007 Plans:

-Complete development of platform concepts for autonomous mine neutralization by AUVs.
-Complete assessment of dart dispenser concepts using computational tools and engineering level models.
-Complete development of mine vulnerability database for kinetic damage, shock, blast and thermal effects.
-Complete development of models to assess performance of bombs against mines in VSW.
-Complete development of mine jamming effectiveness tool.
-Complete assessment of mine jamming using ICCP; and complete mine jamming effort with exit demonstration on representative mine field using USS Higgins Guided Missile Destroyer(DDG-76) or LPD-17.
-Continue development of advanced computational models for high speed water entry and penetration.
-Continue development of advanced computational tools for predicting soil penetration by countermine darts.

	FY 2004	FY 2005	FY 2006	FY 2007
MINE TECHNOLOGY	187	198	200	201

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

FY 2004 Accomplishments:

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

-Continued assessment of advanced sea mine technologies.

FY 2005 Plans:

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

FY 2006 Plans:

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

FY 2007 Plans:

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

	FY 2004	FY 2005	FY 2006	FY 2007
ASSAULT BREACHING SYSTEM	5,597	0	0	0

Assault Breaching System concepts will lead to a future mine and obstacle breaching capability. The employment of air and surface strike weapon systems will minimize exposure to service personnel, enable amphibious landing forces to maintain an unencumbered operational tempo from the sea to the objectives ashore, and reduce total ownership costs and logistics requirements. It supports the future naval warfare directions of power projection, operational maneuver from the sea, Ship-to-Objective Maneuver, and sea-based logistics. Funding for this effort for FY 2005 and out is budgeted and executed by NAVSEA Mine Undersea Warfare.

FY 2004 Accomplishments:

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

BUDGET ACTIVITY: 02
PROGRAM ELEMENT: 0602782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH
PROJECT TITLE: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
MOBILE UNDERWATER COASTAL SURVEILLANCE SYSTEM	964	0

This effort developed control algorithms to effect cooperative behavior among multiple autonomous underwater vehicles in specific, extended duration mission scenarios. Duration was achieved through the use of vehicles capable of harvesting solar energy from the environment.

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

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

D. ACQUISITION STRATEGY:
Not applicable

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N
PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	229,851	135,758	82,538	84,043	81,395	113,630	121,596	63,449
R2487 DP-2 VECTORED THRUST AIRCRAFT PROGRAM	4,806	7,429	0	0	0	0	0	0
R2821 INTEGRATED HYPERSONIC AEROMECHANICS TOOL PROGRAM (IHAT)	3,387	0	0	0	0	0	0	0
R2823 PRECISION STRIKE NAVIGATOR (PSN)	968	0	0	0	0	0	0	0
R2911 POWER PROJECTION ADVANCED TECHNOLOGY/IHPRPT	167,827	85,324	82,538	84,043	81,395	113,630	121,596	63,449
R3022 JOINT NON LETHAL WEAPONS	0	311	0	0	0	0	0	0
R9008 FREE ELECTRON LASER (FEL)	2,074	2,179	0	0	0	0	0	0
R9010 VARIABLE ENGINE NOZZLE	1,444	0	0	0	0	0	0	0
R9012 MAGDALENA RIDGE OBSERVATORY	10,087	0	0	0	0	0	0	0
R9134 HIGH SPEED ANTI-RADIATION DEMONSTRATION (HSAD)	4,942	4,953	0	0	0	0	0	0
R9136 ADVANCED LIFTING BODY RESEARCH PROGRAM	4,831	4,953	0	0	0	0	0	0
R9292 ADVANCED THIN FILM COATINGS	4,812	1,684	0	0	0	0	0	0

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N
PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY

R9293	HI SPD, HEAVY LIFT, SHALLOW DRAFT-CAPABLE WATERCRAFT							
	7,383	0	0	0	0	0	0	0
R9294	INTEGRATED HIGH PAYOFF ROCKET PROPULSION TECHNOLOGY PROGRAM (IHPRPT)							
	987	0	0	0	0	0	0	0
R9295	LARGE AREA MULTI-SPECTRAL SAPPHIRE WINDOWS FOR AIRBORNE RECON							
	1,639	0	0	0	0	0	0	0
R9296	LADAR-LASER RADAR							
	2,924	2,081	0	0	0	0	0	0
R9297	LOW POWER MEGA-PERFORMANCE UAV PROCESSING ENGINES							
	1,442	1,981	0	0	0	0	0	0
R9298	LOW-COST TERMINAL IMAGING SEEKER							
	2,924	4,457	0	0	0	0	0	0
R9299	ADVANCED TECHNOLOGIES FOR PRINTED WIRING ASSEMBLY FABRICATION							
	4,096	3,368	0	0	0	0	0	0
R9302	UNCOOLED HIGH RESOLUTION INFRARED SENSORS							
	3,278	0	0	0	0	0	0	0
R9432	CENTER FOR COASTLINE SECURITY TECHNOLOGY							
	0	2,477	0	0	0	0	0	0
R9446	ADVANCED ELECTRIC DRIVES							
	0	1,485	0	0	0	0	0	0
R9447	ARTICULATED STABLE OCEAN PLATFORM							
	0	991	0	0	0	0	0	0
R9449	HIGH OPERATING TEMPERATURE MIDWAVE INFRARED SENSORS							
	0	1,684	0	0	0	0	0	0
R9450	MULTI-FUNCTIONAL, HIGH-PERFORMANCE DUAL BAND IMAGING							
	0	1,684	0	0	0	0	0	0
R9451	QUIET HIGH SPEED PROPULSION							
	0	3,566	0	0	0	0	0	0
R9452	SPACE SURVEILLANCE TECHNOLOGY							

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N
PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY

	0	3,467	0	0	0	0	0	0
R9453	ULTRA-SHORT PULSE LASER MICROMACHINING						
	0	1,684	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program develops and demonstrates advanced technologies, including Directed Energy, for naval weapon systems, and Electric Warship. This Program Element (PE) includes elements of the following Future Naval Capabilities (FNCs); Time Critical Strike (TCS), Autonomous Operations (AO), and Knowledge Superiority Assurance (KSA). 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.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N
PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	260,688	92,359	69,501	66,634
Cong Rescissions/Adjustments/Undist. Reductions	0	-1,363	0	0
Congressional Action	0	50,600	0	0
Execution Adjustments	-24,987	0	0	0
FNC Realignment	0	0	1,875	7,268
Non-Pay Inflation Adjustments	-244	0	0	0
Program Adjustments	-3,528	-5,838	11,038	9,733
Rate Adjustments	0	0	124	408
SBIR Assessment	-2,078	0	0	0
FY 2006/2007 President's Budget Submission	229,851	135,758	82,538	84,043

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2911 PROJECT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY/IHPRPT

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R2911 POWER PROJECTION ADVANCED TECHNOLOGY/IHPRPT	167,827	85,324	82,538	84,043	81,395	113,630	121,596	63,449

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

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
PRECISION STRIKE TECHNOLOGY	33,923	37,797	52,044	49,263

This project focuses on the development of high speed (Mach 3 to Mach 4+) propulsion technologies that will support the development of strike weapons that will significantly decrease the launch to engagement timeline. Investments under this activity were previously reported under the Time Critical Strike Future Naval Capability (FNC). This new Activity breakout provides improved clarification of the overall investment scope. Increase in FY 2006 and FY 2007 is due to a program adjustment for HyFly and NAI RATTLRS.

FY 2004 Accomplishments:
- National Aerospace Initiative Revolutionary Approach To Time-critical Long Range Strike (NAI RATTLRS): Completed System Definition of the design leveraging the Integrated High-Performance Turbine Technology project's Joint Expendable Turbine Engine Concepts (JETEC) thrust. Initiated studies to identify potential concepts that address performance of the first flight demonstration vehicle, and depict the evolution into weaponized configurations.
- Exploitation and Deployment Efforts: Completed casting of HyFly Airframe. Completed Sled Test to demonstrate stage separation.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2911 PROJECT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY/IHPRPT

FY 2005 Plans:
- NAI RATTLRS: Initiate inlet/engine/nozzle integration and component testing. Initiate fabrication of long lead flow path hardware and ground testing of airframe configurations. Initiate design & risk reduction activities which lead to preliminary design.
- Exploitation and Deployment efforts: Continue HyFly project efforts by conducting unpowered flights to demonstrate aircraft separation and booster powered flight.

FY 2006 Plans:
NAI RATTLRS: $8,500
Hy-Fly: $11,500
- NAI RATTLRS: Complete a preliminary design review of the proposed concept. Fabricate safe separation flight test vehicles and flight test hardware. Accelerate technical development of individual components.
- Exploitation and Deployment efforts: Complete two fully powered HyFly flights to demonstrate flight worthiness.

FY 2007 Plans:
NAI RATTLRS: $18,000
HyFly: $2,000
- NAI RATTLRS: Complete final component demonstrations and validations along with a critical design review. Conduct system checkouts and fabrication of flight demonstration vehicles. Perform a safe separation flight test.
- Exploitation and Deployment efforts: Complete four fully powered HyFly flights to demonstrate flight performance.
- Electromagnetic Gun (EM) Gun: Develop and fabricate a full scale proof of concept 32 mega joules (muzzle energy) demonstrator for testing of integrated launch package in 2009. Conduct testing of capacitor based pulse forming network system to 32 mega joules (of 100 required) of stored power with prototypical rail gun system.

	FY 2004	FY 2005	FY 2006	FY 2007
JOINT UNMANNED COMBAT AIR SYSTEM	102,591	0	0	0

The Office of Naval Research supports the Defense Advanced Research Project Agency (DARPA) - led Joint Unmanned Combat Air Systems (J-UCAS) effort (formerly Unmanned Combat Aerial Vehicle - (Naval Version)), in conjunction with Air Force, to develop and demonstrate technical feasibility, military utility and operational

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2911 PROJECT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY/IHPRPT

value for a networked system of high performance, weaponized unmanned air vehicles to effectively and affordably prosecute 21st century combat missions – including suppression of enemy air defenses, collaborative electronic attack, penetrating surveillance, and deep strike – within the emerging global command and control architecture. Multi-year funding in this project will provide for two robust flight demonstrations to encourage innovation, fully explore the potential, and develop options for reduced risk transition to acquisition.

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

FY 2004 Accomplishments:
- Continued design and planning tasks. Initiated detailed air vehicle, surrogate, and MCS software design and air vehicle fabrication. Performed mission control at sea demonstration and preliminary, midterm and critical design reviews. This effort transitions to DARPA in FY 2005.

	FY 2004	FY 2005	FY 2006	FY 2007
TIME CRITICAL STRIKE	19,809	31,163	8,868	15,374

This activity supports the Future Naval Capability program in Time Critical Strike (TCS). The specific mission of TCS integrates surveillance, indications and warnings, target identification, targeting, fire order generation and dissemination, engagement and kill mechanisms, and damage assessment processes to address critical mobile targets, urban targets, short dwell targets and deeply buried targets. TCS technologies reduce the time to conduct strike in all functional areas of the kill chain. This activity includes support to the following TCS related Enabling Capabilities: Advanced Sensors; Automated Control of Large Sensor Networks; Advanced Naval Fires Technology; Dynamic Target Engagement & Enhanced Sensor Capabilities; Hostile Fire Detection and Response; Marine and Unmanned Vehicles Tactical Intelligence Surveillance & Reconnaissance (ISR); Mine Countermeasures Capacity; and Rapid Covert Surveillance System Deployment and Light Weight Torpedo Improvement.
Decrease in funding from FY 2005 to FY 2006 is due to completion of initiatives. Increase in funding from FY 2006 to FY 2007 is due to new initiatives.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2911 PROJECT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY/IHPRPT

FY 2004 Accomplishments:
- Advanced Gun Barrel & Targeting Technology (AGTT): Continued development and scaled testing of advanced composite liners for gun (Naval, 5") systems.
- Real Time Execution Decision Support: Completed software implementation and system and unit level test.
- Cruise Missile Real Time Retargeting (CMRTR): Continued development of V.3 and V.4 sensors for low cost terminal seeker, and test subcomponents of V.3 sensor.
- Precision Strike Navigator (PSN): Continued development of chemical and mechanical processes for low cost precision Fiber Optic Gyro (FOG) Inertial Measurement Unit (IMU), and provide low accuracy unit for evaluation.
- High-Speed Anti Radiation Missile (HSARM): Continued development and subsystem test of an advanced dual mode anti-radiation missile seeker incorporating advanced seeker, aperture, guidance and control technologies for a ramjet-powered missile airframe.
- Hyper Spectral Imaging: Completed integration of visible sub-system with near and far infra-red spectrometers, optical train, selected position/pointing system reference, and enhanced detect algorithms for real time processor.

FY 2005 Plans:
- AGTT: Continue prior year efforts and begin large scale gun prototyping with materials selected.
- CMRTR: Continue program by performing full system test of V.3 sensor, continue development of V.4 sensor for low cost terminal seeker, integrate V.2, V.3 sensors with V.4, and perform V.4 subsystem tests.
- PSN: Continue development of low cost precision FOG IMU and deliver updated high accuracy unit ready for evaluation.
- HSARM: Complete development, subsystem, and system level flight test demonstration of an advanced dual mode anti-radiation missile seeker for a ramjet-powered missile airframe. Classified effort will develop classified seeker technology for time critical targeting.
- Low-Cost Guided Imaging Rocket: Complete effort to develop a low-cost rocket system that uses an imaging seeker which can be used against a wide variety of targets.
- Ground Moving Target Indicator (GMTI) Capability: Begin initial planning for a low-cost, single board radar system suitable for use on a long endurance Unmanned Air Vehicle (UAV).

FY 2006 Plans:
- AGTT: Take completed analytical modeling and scaled prototypes of advanced liner coatings and aluminum composite metal matrix material designs and complete fabrication of a full scale composite barrel test section.

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PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
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- HSARM: Complete classified effort to develop seeker technology for time critical targeting.
- GMTI Capability: Initiate task to provide a low-cost, single board radar system suitable for use on a long endurance UAV.
- Ultra Endurance UAV: Initiate effort to provide affordable, high endurance platform/propulsion with Commercial Off the Shelf (COTS) and modified COTS components for persistent ISR, targeting, Bomb Damage Assessment/Bomb Damage Indication (BDA/BDI), and weapon delivery.

FY 2007 Plans:
- AGTT: Complete testing and transition improved coatings and composite 155mm full scale Naval Gun Advanced Prototype Barrel with advanced longer life bore liner. Transition effort to DD(X) R&D effort.
- GMTI Scout: Complete the preliminary design of a low-cost, single board GMTI radar system suitable for use on a long endurance UAV.
- Ultra Endurance UAV: Complete the preliminary design for long endurance UAV propulsion components with payload capacity greater than 250 pounds. The design will include the capability for ship recovery and to dispense sensor fused weapons.
- Near Real Time BDA/BDI System: Complete assessment of existing BDA and BDI tools and procedures to determine the current state of the technology. Initiate task to provide near real time battle damage information required to evaluate mission effectiveness. This task will exploit existing sensors and if necessary modify sensors to meet requirements.
- Image Video Analysis: Initiate effort to provide the capability to detect targets and assess battle damage from imagery and video captured by various manned and unmanned platforms.
- Real-Time Ground Moving Target: Initiate task to provide the capability to detect and fix moving targets in near real time. Conduct system level analyses to determine the feasibility of detecting and fixing moving targets using image processing of streaming video in near real-time from a UAV (or other image/video provider).
- Affordable, Persistent ISR: Initiate task to provide a theater-quality low-cost ISR system integrated on a long endurance UAV. Conduct system analyses and trade studies to determine the technical feasibility of fielding an Electro-Optic/Infrared system, determine the recurring cost for the sensor system, and identify any high risk technology issues.

	FY 2004	FY 2005	FY 2006	FY 2007
AUTONOMOUS OPERATIONS (AO)	11,504	16,364	21,626	19,406

The Autonomous Operations (AO) Future Naval Capability (FNC) activity aims to enhance the mission capability

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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 (IA) Science and Technology principles, transitional products will be developed in four areas: Unmanned Air Vehicles (UAV) Technology, which includes IA reasoning, technologies to enhance “see and avoid” capabilities, object identification, vehicle awareness, and vehicle and mission management; Unmanned Undersea Vehicles (UUV), which will demonstrate the technical feasibility for a UUV system to effectively search, detect, track and trail undersea threats while maintaining a robust communications link to enable appropriate command, control and transmission of collected data; Unmanned Ground Vehicles (UGV), which focus on the increasing utility of UGV systems in urban and littoral terrain to Marine Corps units; and UAV Propulsion, which will develop innovative propulsion and power technologies unique to Naval UAVs operating from surface combatants. This activity also contains a task from the Knowledge Superiority Assurance FNC.
Increase in funding from FY 2004 to FY 2006 is due to new initiatives. Decrease in funding from FY 2006 to FY 2007 is due to completion of initiatives.

FY 2004 Accomplishments:
- IA Task: Continued testing and demonstrating intelligent vehicle technologies. Completed high fidelity simulation of tightly integrated path replanning and on-board mapping with AO UUV development effort.
- UAV Technology: Continued developing and performing simulation testing of sensors and sensor software and the development of multi-modal interface control. Continued development of UAV networking and communication with loaned Joint Tactical Radio System (JTRS) prototype radios for demonstration in the FIRESCOUT.
- UUV: Continued work developing and demonstrating undersea operations for Maritime Reconnaissance (MR) and Undersea Search and Survey (USS). Demonstrated integrated Intelligence Surveillance & Reconnaissance (ISR) mast and ElectroMagnetic/ElectroOptic scout sensors on a 21" diameter UUV along with advanced autonomous control software including ISR sensor cueing, autonomous path planning, and obstacle avoidance.
- UGV: Completed work on mobility UGV test bed. Transitioned to Marine Corps for System Development Design.
- UAV Propulsion: Continued development of thermal management, integrated power generation, and integrated inlet/engine control in future naval UAV propulsion systems as a part of the Integrated High Performance Turbine Engine Technology (IHPTET) Program. Conducted ground test of the enhanced next-generation commercial gas generator core.

FY 2005 Plans:
- IA Task: Continue in-water and simulation testing and demonstrating of dynamic replanning and autonomous vehicle control technologies. Conduct in-water demonstration of maritime situation awareness technology and

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simulation testing of dynamic replanning capability in a simulated warfare environment integrated with a Naval control station.
- UAV Technology: Continue work developing and performing simulation testing of sensors and sensor software and the development of multi-modal interface control. Develop and conduct testing of self-awareness sensor software and sub-system self-awareness sensors. Demonstrate UAV networking and communication with loaned JTRS prototype radios for demonstration in FIRESCOUT.
- UUV: Continue work developing and demonstrating undersea operations for MR technologies, including transition of ISR Mast and advanced autonomy for 21-in UUV and autonomous docking station for small UUVs; continue development and testing of USS and Communications/Navigation Aids technologies.
- UAV Propulsion: Conduct ground test of the XTE-67/A1 UAV demonstrator engine with Naval-unique technologies and integrate with the enhanced next-generation commercial core and a Mach 3.5 capable expendable turbine engine for missile applications. This meets IHPTET phase III Joint Expendable Turbine Engine Concept goals and is a foundation for the Versatile Affordable Advanced Turbine Engine program.

FY 2006 Plans:
- IA Task: Complete testing and demonstration of dynamic replanning technologies including high-fidelity simulation of multiple classes of Naval unmanned vehicles in a simulated warfare environment, hardware, and in-water demonstrations. Continue testing and demonstration of multi-vehicle cooperation technologies.
- UAV Technology: Continue testing and demonstration of multi-modal interface control. Complete performing simulation testing of sensors and sensor software.
- UUV: Transition USS and Communication Navigation Aid products to Program Management Office-Explosive Ordnance Disposal and Office of Naval Intelligence (ONI-34); standup Submarine Track and Trail (STT) efforts in the areas of advanced undersea sensors, communications, and autonomy.
- UAV Propulsion: Continue ground test of the XTE-67/A1 UAV demonstrator engine with naval-unique technologies and integrate with the enhanced next-generation commercial core and a Mach 3.5 capable expendable turbine engine for missile applications.
- Reconfigurable Surveillance UAV's (RSU): This effort will develop surveillance UAV's that can be reconfigured to support different packages in order to better provide protection to the warfighters.

FY 2007 Plans:
- IA Task: Complete testing and demonstration of multi-vehicle cooperation technologies including high-fidelity simulation of multiple heterogeneous Naval unmanned vehicles in a simulated warfare environment, hardware, and in-water demonstrations.
- UAV Technology: Complete testing and demonstration of multi-modal interface control.

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- UUV: Continue STT efforts in the areas of advanced undersea sensors, communications, and autonomy.
- UAV Propulsion: Continue ground test of the XTE-67/A1 UAV demonstrator engine with naval-unique technologies and integrate with the enhanced next-generation commercial core and a Mach 3.5 capable expendable turbine engine for missile applications.
- RSU: Complete development of reconfigurable surveillance UAV's for warfighter protection.

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 Joint Director of Laboratories.

PE 0603285E Advanced Aerospace Systems
PE 0603709D8Z Joint Robotics Program
PE 0604709D8Z Joint Robotics Program - EMD
PE 0602203F Aerospace Propulsion
PE 0603216F Aerospace Propulsion and Power Technology
PE 0603205F Flight Vehicle Technology

D. ACQUISITION STRATEGY:

Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R3022 PROJECT TITLE: JOINT NON LETHAL WEAPONS

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R3022 JOINT NON LETHAL WEAPONS	0	311	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project develops technology for non-lethal weapons and supports the Joint Non-Lethal Weapons Office. This project was transferred to Program Element 0603651M in FY 2005.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
JOINT NON-LETHAL WEAPONS (NLW) PROGRAM	0	311	0	0

This project develops the next-generation Non-Lethal Weapons (NLWs) and includes efforts to ensure optimum weaponization and use of these NLWs. Next-generation NLW systems focus on long-range localized Non-Lethal (NL) effects to identified threat individuals (or groups of individuals) and/or their threat weapons systems operating in complicated environments such as urban areas, crowds, buildings, vehicles, boats and also in close proximity to high-value civilian establishments. This project was transferred to Program Element 0603651M in FY 2005.

C. OTHER PROGRAM FUNDING SUMMARY:
Not Applicable.

D. ACQUISITION STRATEGY:
Not Applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603114N PROGRAM ELEMENT TITLE: POWER PROJECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

R2487	FY 2004	FY 2005
DP-2 VECTORED THRUST AIRCRAFT PROGRAM	4,806	7,429

FY04 - This effort developed and installed vehicle redesigns, including improved NASA-designed cascade vanes. Test failure occurred during buildup to controlled hover. Continued development of control system hardware.
FY05 - This effort will install additional vehicle improvements to increase hover performance and reliability: lightweight fuselage and wing, robust nozzle box and cascade mechanism. Resume controlled hover tests and complete sustained controlled hover, in and out of ground effects.

R2821	FY 2004	FY 2005
INTEGRATED HYPERSONIC AEROMECHANICS TOOL PROGRAM (IHAT)	3,387	0

This effort developed a prototype aeromechanical tool for modeling control technologies for future hypersonic flight vehicles. FY 2004 tasks added additional functionality to the existing modules and added the following new modules: Mission, Lethality, and Cost Index.

R2823	FY 2004	FY 2005
PRECISION STRIKE NAVIGATOR (PSN)	968	0

This effort fabricated a pre-production transceiver device using the Precision Strike Navigator (PSN) prototype facility at Army Missile Command. The effort continued process development for low cost manufacture of the unique PSN devices and their applications.

R9008	FY 2004	FY 2005
FREE ELECTRON LASER	0	2,179

This effort will develop a capability to support the operation of a 7 MeV high current injector in the free electron laser facility. The task will include processing and characterization of super conducting radio frequency cavities which will be assembled in a cryounit for a systems test.

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R9008	FY 2004	FY 2005
HEL-LOW ASPECT TARGET TRACKING (HEL-LATT)	2,074	0

This effort completed upgrades to seaLite beam director tracking system. New cameras, optical systems were installed. Multiple High Power Laser tests against targets were conducted.

R9010	FY 2004	FY 2005
VARIABLE ENGINE NOZZLE	1,444	0

This effort conducted a lab demonstration of a variable displacement van pump and initiated Phase II integration with a demonstration engine.

R9012	FY 2004	FY 2005
MAGDALENA RIDGE OBSERVATORY	10,087	0

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

R9134	FY 2004	FY 2005
HIGH SPEED ANTI-RADIATION DEMONSTRATION (HSAD)	4,942	4,953

FY04: This effort developed a producible digital control actuator system for the missile aft steering system of the High Speed Anti-Radiation Demonstration (HSAD) airframe, developed design concepts and built multiple proof of concept subcomponent prototypes.
FY05: This effort will mature key areas in the propulsion elements of the HSAD advanced anti-radiation guided missile. The efforts will better characterize the subsystem performance with addition testing, ramjet fuel development, insensitive munitions development, propulsion system optimization studies and propulsion requirements development through operational/mission analysis.

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R9136	FY 2004	FY 2005
ADVANCED LIFTING BODY RESEARCH PROGRAM	4,831	4,953

FY04 - This effort studied known issues in the further development of lifting body technology that was demonstrated in a series of vessels, culminating in the large lifting body vessel SEA FLYER.
FY05 - This effort will work on issues arising from commercialization efforts coming from technology transfer.

R9136	FY 2004	FY 2005
HIGH SPEED, HEAVY-LIFT, SHALLOW DRAFT-CAPABLE WATERCRAFT DEMONSTRATION	7,383	0

This effort developed a design for a dual-use, SWATH-like craft. Commercial use is as a ferry in regions of high tidal variations. Military use would be as a half-scale demonstrator of beachable, littoral transport.

R9292	FY 2004	FY 2005
ADVANCED THIN FILM COATINGS	4,812	1,684

FY04 - This effort developed and demonstrated light-weight paint pigments and thin light-weight flexible organic light emitting diode film technologies for Naval Aviation applications on MV-22.
FY05 - This effort will demonstrate light-weight, durable paint-replacement film development and manufacturing. The goal of this task is to reduce the cost, weight, and maintenance associated with paint replacement films for military aircraft.

R9294	FY 2004	FY 2005
INTEGRATED HIGH PAYOFF ROCKET PROPULSION TECHNOLOGY PROGRAM (IHPRPT)	987	0

This effort developed and demonstrated advanced propulsion technologies that increase the kinematic performance of weapons systems while meeting the goals of the Integrated High Payoff Rocket Propulsion Technology program.

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PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9295	FY 2004	FY 2005
LARGE AREA MULTI-SPECTRAL SAPPHIRE WINDOWS FOR AIRBORNE RECONNAISSANCE	1,639	0

This effort developed large area, high transmission, low cost, high durability entrance windows for integrated electro-optic and infrared sensors for Navy, Marine Corps and Army platforms.

R9296	FY 2004	FY 2005
LADAR-LASER RADAR	2,924	2,081

FY04 - This effort developed an improved missile seeker to search larger areas at faster speed to improve performance against occluded targets. Funds were used to develop improvements to the ladar electronics that reduce system noise and improve performance of the seeker.
FY05 - This effort will develop autonomous target recognition techniques, using ladar data, that can be employed in an anti-ship role.

R9297	FY 2004	FY 2005
LOW POWER MEGA-PERFORMANCE UAV PROCESSING ENGINES	1,442	1,981

FY04 - This effort developed microcode for 3D synthetic aperture radar on existing 64 node 23 giga-loating point operations per second (GFLOPS) Sequential Instruction Multiple Data (SIMD) processing chip and laid out real-time 256 node chip to achieve 104 GFLOPS.
FY05 - This effort will develop and deliver a SIMD integrated processing chip capable of 96 GFLOPS along with macro code software modules to process synthetic aperture radar onboard a small tactical unmanned aerial vehicle.

R9298	FY 2004	FY 2005
LOW-COST TERMINAL IMAGING SEEKER	2,924	4,457

FY04 - This effort developed a low cost rocket system that uses an imaging seeker and can be used against a wide variety of targets. Funds provided developed a simulation environment to support requirements analysis

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and preliminary design and initiated development of a fully compliant inertial measurement unit.
FY05 - This effort will conduct additional modeling and simulation to improve characterization of the performance of the system and data collection and develop algorithms to improve the system performance in signal processing.

R9299	FY 2004	FY 2005
ADVANCED TECHNOLOGIES FOR PRINTED WIRING ASSEMBLY FABRICATION (PWB-HVPC)	4,096	3,368

FY04 - This effort developed vertical interconnect technology for silicon wafer scale circuitry onto Printed Wiring Boards (PWBs). Conducted advanced multilayer PWB ultrasonic analysis by employing direct sequence spread spectrum technology.
FY05 - This effort will develop technologies and techniques to reverse engineer and repair multilayer printed circuit boards in Navy systems. Technologies include applying discrete sequence spread spectrum technologies for high resolution imaging of multilayer boards and laser assisted through hole and line metallization on boards.

R9302	FY 2004	FY 2005
UNCOOLED HIGH RESOLUTION INFRARED SENSORS	3,278	0

This effort developed uncooled infrared sensors based on advanced metal doped, ion-implanted, organic polymer based materials. This effort produced high resolution 640x480 infared sensors. Experimental devices have demonstrated higher performance, ease in fabrication, higher uniformity, and substantially lower fabrication costs than current inorganic material sensors.

R9432	FY 2004	FY 2005
CENTER FOR COASTLINE SECURITY TECHNOLOGY	0	2,477

This effort will develop and deliver visible and infrared sensors for harbor and coastal 24 hour all weather surveillance. Sensors will be integrated on underwater, surface, and airborne unmanned vehicles as well as at the Naval Surface Warfare Center Carderock’s South Florida Test Facility along with attendant signal processing.

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R9446	FY 2004	FY 2005
ADVANCED ELECTRIC DRIVES	0	1,485

This effort will support advanced electric drives.

R9447	FY 2004	FY 2005
ARTICULATED STABLE OCEAN PLATFORM	0	991

This effort will develop a numeric tool for general articulated offshore platforms using simulation models previously developed.

R9449	FY 2004	FY 2005
HIGH OPERATING TEMPERATURE MIDWAVE INFRARED SENSORS	0	1,684

This effort will develop and evaluate high performance medium wavelength infrared sensors of pixel size 320x240 with 640x480 goal for Navy, Marine Corps, and Army needs.

R9450	FY 2004	FY 2005
MULTI-FUNCTIONAL, HIGH-PERFORMANCE DUAL BAND IMAGING	0	1,684

This effort will research and develop sensor issues associated with multi-band infared and radio frequency sensors for detection and track of asymmetric maritime threats.

R9451	FY 2004	FY 2005
QUIET HIGH SPEED PROPULSION	0	3,566

This effort will develop an advanced hub-driven podded propulsor design for surface ship and submarine applications. The system will have the attributes of reduced low-speed acoustic and electromagnetic signatures, be power dense, and provide high-speed platform performance.

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R9452	FY 2004	FY 2005
SPACE SURVEILLANCE TECHNOLOGY	0	3,467

This effort will support space surveillance technology.

R9453	FY 2004	FY 2005
ULTRA-SHORT PULSE LASER MICROMACHINING	0	1,684

This effort will develop and deliver femtosecond lasers for micromachining of silicon and other materials.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N
PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	128,088	180,641	71,488	56,070	45,859	40,924	62,513	76,976
R2706 PROJECT M	4,805	1,882	0	0	0	0	0	0
R2711 SUPERCONDUCTING DC HOMOPOLAR MOTOR	5,391	3,666	0	0	0	0	0	0
R2828 ADVANCED WATERJET-21	1,944	0	0	0	0	0	0	0
R2831 AC SYNCHRONOUS HIGH TEMP SUPERCONDUCTOR (HTS) ELECTRIC MOTOR	5,783	3,467	0	0	0	0	0	0
R2912 FORCE PROTECTION ADVANCED TECHNOLOGY	60,027	72,751	65,715	49,715	39,272	34,194	55,416	69,588
R3049 FORCE PROTECTION	5,068	8,523	5,773	6,355	6,587	6,730	7,097	7,388
R9013 LITTORAL SUPPORT CRAFT - EXPERIMENTAL	13,452	9,906	0	0	0	0	0	0
R9014 PRECISION FABRICATION OF LARGE CURVED STEEL SHIP STRUCTURES	2,411	0	0	0	0	0	0	0
R9017 WIRELESS SENSOR NETWORK	961	0	0	0	0	0	0	0
R9019 WAVE POWER DEMONSTRATION PROJECT	3,278	3,368	0	0	0	0	0	0
R9023 AFFORDABLE, INTERMEDIATE MODULUS COTS CARBON FIBER QUALIFICATION PROGRAM FOR AIRCRAFT AND MISSILES								

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	0	991	0	0	0	0	0	0
R9139	SANDWICH PANEL CONSTRUCTION							
	0	3,963	0	0	0	0	0	0
R9140	HIGH SPEED PERMANENT MAGNET GENERATOR							
	3,460	6,438	0	0	0	0	0	0
R9143	SMART SENSOR WEB ADVANCED TECHNOLOGY							
	0	1,784	0	0	0	0	0	0
R9293	VARICRAFT							
	0	6,241	0	0	0	0	0	0
R9303	AGILE PORT & HI SPEED SHIP/MOBILITY-21 DEPL TECH							
	4,826	9,212	0	0	0	0	0	0
R9304	AVIATION GROUND NAVIGATION SYSTEM (AGNAS)							
	1,636	991	0	0	0	0	0	0
R9305	COMPOSITE SPECIAL OPERATIONS CRAFT							
	964	0	0	0	0	0	0	0
R9306	DOCK SHOCK							
	964	4,260	0	0	0	0	0	0
R9307	E-2C INFRARED SEARCH AND TRACK (IRST) TECHNOLOGY EXPERIMENTATION							
	1,325	0	0	0	0	0	0	0
R9308	GLOBAL PERSONAL LOCATOR BEACON (PLB)							
	1,686	0	0	0	0	0	0	0
R9309	LARGE UNMANNED UNDERSEA VEHICLE (LUUV) TEST BED							
	1,154	1,684	0	0	0	0	0	0
R9310	LASER WELDING AND CUTTING							
	3,364	0	0	0	0	0	0	0
R9311	QUAD HULL SECURITY CAISSON TECHNICAL DEMONSTRATION							
	2,411	0	0	0	0	0	0	0
R9312	REMOTE CONTINUOUS ENERGETIC MATERIAL MANUFACTURING PYROTECHNIC IR DECOYS							
	1,154	0	0	0	0	0	0	0

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N
PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

R9313	TECHNOLOGIES FOR FUTURE NAVAL CAPABILITIES							
	1,060	1,288	0	0	0	0	0	0
R9314	WIRELESS PROGRAMMABLE LOGIC CONTROLLERS							
	964	0	0	0	0	0	0	0
R9344	EXTREME TERRAIN MEDICAL EVACUATION VEHICLE PILOT							
	0	1,684	0	0	0	0	0	0
R9454	ADVANCED DEVELOPMENT AND DEMONSTRATION OF ELECTRIC ACTUATOR TECHNOLOGY							
	0	991	0	0	0	0	0	0
R9455	AT-SEA DECONTAMINATION PLATFORM DEVELOPMENT AND CONCEPTUAL DESIGN							
	0	991	0	0	0	0	0	0
R9456	BRAIDED REDUCED RECOIL ROPE FOR HAND AND MOORING LINES							
	0	991	0	0	0	0	0	0
R9457	COMPOSITE TWISTED RUDDER							
	0	991	0	0	0	0	0	0
R9458	DEPLOYABLE FIBER OPTIC FORCE PROTECTION SYSTEM							
	0	1,784	0	0	0	0	0	0
R9459	DEVELOPMENT OF WIDE BANDGAP SEMICONDUCTOR MATERIALS							
	0	4,457	0	0	0	0	0	0
R9461	ELECTROMAGNETIC PROPULSION COST REDUCTION							
	0	1,388	0	0	0	0	0	0
R9462	FUTURE NAVAL CAPABILITIES - CREW MODELING AND SIMULATION (FNC-CMS)							
	0	2,576	0	0	0	0	0	0
R9463	HIGH-SPEED POWER NODE SWITCHING CENTER							
	0	1,388	0	0	0	0	0	0
R9464	INTEGRATED ADVANCED COMMUNICATIONS TERMINAL (ACT)							
	0	991	0	0	0	0	0	0
R9465	MISSILE WARNING SENSOR							
	0	2,477	0	0	0	0	0	0
R9466	MULTI-MISSION WARHEAD FOR ULTRA-LIGHT TORPEDO							

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N
PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

	0	2,279	0	0	0	0	0	0
R9467	NON-LINE OF SIGHT (NLOS) FOR UNMANNED SYSTEMS						
	0	4,260	0	0	0	0	0	0
R9468	DEVELOPMENT OF SULFER TOLERANT COPPER-BASED SOLID OXIDE FUEL CELL (SOFC)						
	0	991	0	0	0	0	0	0
R9469	TADIRCM ANTIMISSILE TECHNOLOGY						
	0	6,736	0	0	0	0	0	0
R9470	UNMANNED FORCE AUGMENTATION SYSTEM						
	0	991	0	0	0	0	0	0
R9471	UNMANNED SYSTEMS TECHNOLOGIES FOR EXPLOSIVE ORDNANCE DISPOSAL						
	0	4,260	0	0	0	0	0	0

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. This program supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial and air) and the protection of those platforms. This PE supports the Future Naval Capabilities (FNC) in the areas of Fleet/Force Protection, Advanced Capability Electric Systems (ACES), Total Ownership Cost, and Missile Defense. The goal of this program 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. Surface Ship & Submarine, Hull, Mechanical & Electrical (HM&E), Missile Defense, Fleet Force Protection and Defense against Undersea Threats, and Emerging Threats activities all support FNC efforts.

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

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N
PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	119,838	82,130	55,844	57,302
Cong Rescissions/Adjustments/Undist. Reductions	0	-1,751	0	0
Congressional Action	0	100,300	0	0
Execution Adjustments	10,001	0	0	0
FNC Realignment	0	0	-4,816	-9,751
Non-Pay Inflation Adjustments	-106	0	0	0
Program Adjustments	0	-38	-68	-46
Program Realignment	0	0	20,562	8,177
Rate Adjustments	0	0	-34	388
SBIR Assessment	-1,645	0	0	0
FY 2006/2007 President's Budget Submission	128,088	180,641	71,488	56,070

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not Applicable

Schedule: Not applicable

BUDGET ACTIVITY: 03
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 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R2912 FORCE PROTECTION ADVANCED TECHNOLOGY	60,027	72,751	65,715	49,715	39,272	34,194	55,416	69,588

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 Protection, ACES, 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 2004	FY 2005	FY 2006	FY 2007
SURFACE SHIP & SUBMARINE HULL MECHANICAL & ELECTRICAL (HM&E)	31,521	42,939	23,838	18,300

Activity includes: Signature Reduction, Hull Life Assurance, Distributed Intelligence for Automated Survivability, and Advanced Capability Electric Systems. Signature Reduction addresses Electromagnetic (EM), infrared (IR), and acoustic signature tailoring, both topside and underwater. Hull Life Assurance addresses development of new structural system approaches for surface ships and submarines, including the management of weapon effects to control structural damage and the improvement of structural materials. Distributed Intelligence for Automated Survivability addresses both the basic technology of automating damage control systems, as well as, distributed auxiliary control with self-healing capability. Advanced Capability Electric Systems area addresses electrical and auxiliary system and component technology to provide improvement in system energy and power density, system operating efficiency, and recoverability from casualties. This activity includes support to two FNC Enabling Capabilities: Battlefield Power; and Quiet Drives and Ship Fuel Cell Systems. Additional funding added in FY 2005 by OSD Program Decision Memorandum II (PDM II). This

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

funding will be invested in development of electromagnetic gun technology.

FY 2004 Accomplishments:

- Continued development of advanced main propulsion superconducting motor.
- Continued development of advanced power electronics for Electromagnetic Aircraft Launch System (EMALS) and ship main propulsion systems.
- Continued development of diesel fuel reforming technology for molten carbonate and fuel cells.
- Continued development of Quiet Electric Drive (QED)/secondary propulsion unit (SPU).
- Continued development of superconducting DC homopolar motor.
- Continued technology efforts for reduced total ownership cost.
- Completed fabrication and test of Proton Exchange Membrane (PEM) diesel fuel cell reformer.
- Completed proving ground testing of Reconnaissance, Surveillance, Targeting Vehicle (RSTV).
- Initiated development of electromagnetic gun technology, including focus on rail wear issues, energy storage, and pulsed power switching.
- Initiated development of technologies for future Marine Corps Battlefield Power System.
- Initiated design and construction of 36.5 MW prototype motor.

FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed above.
- Complete development of advanced power electronics for Electromagnetic Aircraft Launch System (EMALS) and ship main propulsion systems.
- Complete Quiet Electric Drive/submarine secondary propulsion unit (SPU).
- Funding from PDM II will be applied to further develop electromagnetic gun technology, including focus on rail wear issues, energy storage, and pulsed power switching (transitions to PE 0602114N in FY 2006).

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Initiate advanced technology portion of on-board vehicle power system by fabricating and beginning component tests (transitioned from FY 2005 efforts under PE 0602123N).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

FY 2007 Plans:

- Continue all efforts of FY 2006.
- Complete testing of advanced main propulsion superconducting motor.

	FY 2004	FY 2005	FY 2006	FY 2007
ADVANCED ENERGETICS	2,820	0	0	0

Advanced Energetics efforts addressed 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 included: advanced energetic materials for thermobarics, agent defeat, and reactive material based warhead subsystems for both defensive and offensive applications. Efforts included development of new fuels, oxidizers, explosive formulations, reliable simulation tools, and diagnostics to develop and design superior performance reduced vulnerability systems tailored to specific warfighter missions.

FY 2004 Accomplishments:

- This activity concludes with the payload development of the Thermobaric Weapon Advanced Concept Technology Demonstration (ACTD) with explosive fill optimization, scale up, full-scale performance validation, and qualification.

	FY 2004	FY 2005	FY 2006	FY 2007
FLEET FORCE PROTECTION AND DEFENSE AGAINST UNDERSEA THREATS	8,182	13,354	23,677	17,815

This Activity is combined and renamed from "Sensors and Associated Processing Activity" and "Underwater Platform Self-Defense Activity" to more accurately describe its scope. Increase in funding in FY 2005 and FY 2006 is due to an increase in demonstration activity.

Fleet Force Protection and Defense against Undersea Threats efforts include applied research for complementary sensor and processing technologies for platform protection and shipboard technologies to increase the survivability of surface ship and submarine platforms against torpedo threats.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

The first major goal of this activity is to develop 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. This activity will provide tactical aircraft (TACAIR) and other platforms with effective threat warning and self-protection. The technology areas specific to platform protection will develop individual or multi-spectral [Electro-Optic (EO), Infra-Red (IR), Radio Frequency (RF), Electromagnetic (EM), visual, and acoustic] sensors and associated processing. To defend platforms from current and advanced threats in at-sea littoral environments and in port, these technologies must improve multi-spectral detection and distribution of specific threat information.

The Fleet Force protection portion of this activity includes support to the FNC Enabling Capabilities for Aircraft Integrated Self-protection Suites, Intent Determination – EO/IR Enhancements, Proof-of-Concept for Non-lethal Approach, and Hostile Fire Detection and Response Spirals 1 and 2.

The second major goal of this activity is to develop enabling technologies that will increase the survivability of surface ship and submarine platforms against torpedo threats. Proposed technologies focus on defeating high priority threats including torpedoes (i.e. straight running, wake homing, acoustic homing, air dropped torpedoes, and salvoes of torpedoes). Technologies developed will minimize shipboard impact and require no organizational maintenance. Two major efforts are ongoing. The Next Generation Countermeasure (NGCM) is a mobile adaptive acoustic countermeasure with acoustic communication links to enable countermeasure connectivity and group behavior for defeat of threat torpedoes. The Anti-Torpedo Torpedo (ATT)/Tripwire provides technologies that improve passive shipboard detection, classification, and localization (DCL) of incoming torpedoes and an ATT to engage the threat torpedoes. The ultimate goal of this effort is to develop a torpedo defense capability to fill Sea Shield Warfighting Capability Gap/Enabling Capability: Platform Defense against Undersea Threats, including Ship Self-Defense Against Multi-Salvo Torpedo Attacks. This will be accomplished by providing a capability to prevent any of the torpedoes in up to four-torpedo salvos fired at high value units from hitting those units. Ultimately the efforts should deliver a netted set of decoys and a counter-torpedo-torpedo for use in detecting and defeating a 4-torpedo salvo attack against a surface or subsurface platform.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

FY 2004 Accomplishments:

Sensors & Associated Processing -
- Completed 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 the Integrated Defensive Electronic Countermeasures (IDECM) Pre-Planned Product Improvement (P3I).
- Completed laboratory and field characterization testing of prototype missile warning sensors with two-color stacked diode focal plane arrays and improved cryogenic coolers for the Missile Warning System (MWS).
- Initiated testing after receiving the first jam head optical dome for testing for the EO/IR Laser Jammer for TACAIR.
- Completed demonstration of the high power thulium fiber laser pump for the mid-wave infrared/visible countermeasure laser system for Shipboard EO/IR Closed Loop Self-protection.
- Completed successful demonstration of the Gun Fire Detection and Situation Awareness software at Ft. Meade, Maryland for the End User Terminal (EUT).
- Initiated Distributed Aperture System (DAS) efforts focusing on design, development, and testing of systems, subsystems, and components for integration of sensor modules and components into a DAS capability demonstration model. This is an international effort to develop new and improved algorithms for DAS Infrared Search and Track (IRST) to cope with at-sea environmental effects.

Underwater Platform Self-Defense –
- Continued open loop in-water data collection efforts to evaluate the ATT sonar technologies for improving operations in the wake.
- Continued in-water open loop data collection experiments to collect ATT sensor data of an emulated threat salvo during relevant engagement geometries.
- Continued requirements analysis for ATT warhead safe-and-arm inertial measurement unit.
- Continued tank tests evaluating the ability of ATT’s to transmit and receive acoustic communication bit sequences.
- Completed development of a Signal Generator Board for ADC MK2 countermeasure format.
- Completed and transitioned NGCM technology: Countermeasure Threat Emulator for Operational Test and Evaluation Force (OPTEVFOR), the Tethered Countermeasure for Tactical Development Exercise (TACDEVEX) evaluation of MK54 torpedo, and ADC MK3/MK4 Mod 1 countermeasures for the fleet.
- Completed and transitioned countermeasure threat emulator to DEVRON12.

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PROJECT NUMBER: R2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

FY 2005 Plans:

Sensors & Associated Processing -
- Continue all efforts of FY 2004 less those noted as completed above.
- Initiate developments for the Laser Detection and Ranging (LADAR) piece of the DAS for target imagery and identification. The LADAR build will see a low power breadboard model.
- Initiate development of the conformal solid-state beam director for the EO/IR Laser Jammer for TACAIR.

Underwater Platform Self-Defense -
- Continue all efforts of FY 2004 less those noted as completed above.
- Complete evaluation of NGCM mobility capabilities in tank tests.
- Initiate closed loop data collections to evaluate ATT 2x2 salvo technologies.

FY 2006 Plans:

Sensors & Associated Processing -
- Continue all efforts of FY 2005.
- Complete land based testing of optical design and data processing systems for DAS.
- Complete international effort to develop new and improved algorithms for DAS IRSTs to cope with at-sea environmental effects.
- Initiate demonstration of the multi-spectral uncooled MWS sensor for the Integrated EO/IR Self Protection Suite for Rotary Wing Aircraft.
- Initiate the integration of the Gallium Arsenide (GaAs) transmitter with an ALE-55 sized Fiber-Optic Towed Decoy (FOTD) and onboard power supply for Integrated Defensive Electronic Countermeasures (IDECM) Pre-planned Product Improvement (P3I).
- Initiate the field demonstration of the full capabilities of the integrated personal communications, situational awareness, and gunfire detection system for EUT.
- Initiate integration and testing of the Shipboard Electro-optic Integrated Defense System's (SHIELD) hardware at NRL's infrared countermeasure techniques development laboratory for Shipboard EO/IR Closed Loop Self-protection.
- Initiate building and testing of LADAR effort to a High Power Pulsed LADAR Brass board model. Integrate Optical design, data processing, and LADAR components and test in simulated at-sea environment. Complete LADAR project and transition to PMS500 for DDX platform.
- Initiate development work on improving imaging technologies (EO/IR/Laser) support IROSS Shipboard

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

Protection System (SPS) Spiral for Integrated Radar Optical Sighting & Surveillance (IROSS).

Underwater Platform Self-Defense -
- Continue all efforts of FY 2005 less those noted as completed above.
- Initiate open loop in-water experiments to evaluate ATT 4x4 engagement technologies.
- Initiate tank experiments to evaluate NGCM Group behavior technology.
- Initiate NGCM controlled mobility at-sea demonstration.

FY 2007 Plans:

Sensors & Associated Processing -
- Continue all efforts of FY 2006 less those noted as completed above.
- Complete laboratory demonstration of both the conformal solid-state beam director and effective countermeasure jamming capability against an imaging missile seeker for the EO/IR Laser Jammer for TACAIR.
- Complete the final at-sea demonstration of the SHIELDs hardware for Shipboard EO/IR Closed Loop Self-protection.
- Initiate in flight tests against single and multiple, simultaneous threats employing the complete IDECM P3I system capabilities, including new towline, decoy, and Electronic Countermeasure (ECM) techniques for IDECM Pre-Planned Product Improvement (P3I).

Underwater Platform Self-Defense -
- Continue all efforts of FY 2006.
- Complete demonstration of one-one ATT operations in the wake and transition technology to PMS415.
- Complete demonstration of ATT 2x2 salvo engagement technology for clear water engagements and transition technology to PMS415.
- Initiate demonstration of a set of NGCM group behaviors and transition technologies to PMS415.

	FY 2004	FY 2005	FY 2006	FY 2007
MISSILE DEFENSE (MD)	2,802	7,149	9,300	10,600

This activity describes Science and Technology (S&T) projects of the Missile Defense Future Naval Capability (FNC) program including: Advanced Area Defense Interceptor (AADI) S&T planning and data analysis effort for Navy-Marine Corps Air-Directed Surface-to-Air Missile (ADSAM) live firing demonstration at White Sands Missile Range in FY 2008; Affordable Ground Based Radar (AGBR) High Mobility Medium Weight Vehicle (HMMWV)-mounted

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

advanced development model (ADM) radar for defense of Marine Corps mobile forces against air and missile attacks; Distributed Weapons Coordination (DWC) (including sensor coordination) open architecture combat system algorithms for automated battle management aids (ABMA), including common threat evaluation (CTE) and preferred shooter recommendation (PSR) functions that will enable fleet units to defend against air and missile attacks with increased effectiveness and efficiency; Littoral Affordability (classified program); and Affordable Ground Based Radar (AGBR) project to reduce risk for an X-band alternative for the Marine Corps Ground/Air Task-Oriented Radar (GATOR) TAMD system (FY 2004 only). Funding increase in FY 2005 is due to an acceleration in DWC efforts.

FY 2004 Accomplishments:

- Continued AADI ADSAM demonstration planning and coordination efforts.
- Continued Littoral Affordability effort (classified program).
- Initiated and completed AGBR project radar group mechanical integration with High Mobility Medium Weight Vehicle (HMMWV) (efforts also included in PE 0603235N). Project completes in FY 2005 under PE 0603271N.
- Initiated testing and demonstration of DWC combat system algorithms developed under PE 0602123N.

FY 2005 Plans:

- Continue all efforts of FY 2004 less AGBR.

FY 2006 Plans:

- Continue AADI and DWC efforts of FY 2005.
- Complete Littoral Affordability effort (classified program).

FY 2007 Plans:

- Continue AADI planning and coordination for FY 2008 Navy ADSAM live-fire demonstration.
- Complete DWC testing and demonstration of CTE and PSR algorithms; continue development and testing of sensor coordination algorithms.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

	FY 2004	FY 2005	FY 2006	FY 2007
HIGH SPEED CRAFT TECHNOLOGY	14,702	9,309	8,900	3,000

This activity was renamed from “Littoral Surface Craft – Experimental (LSC(X))” to more accurately describe the scope of the activity. X-Craft is envisioned as an S&T platform designed for LCS risk reduction and mission module demonstration. A high-speed, all-aluminum catamaran, it displaces 1400 tons at full load. Performance requirements are 50 knots at combat load (about 1200 tons), 40 knots in sea state 4, and a 4000 nautical miles range without replenishment. It will be capable of landing two helicopters up to the size of SH-60R, transporting and operating autonomous vehicles, and carrying several reconfigurable mission modules in standard Twenty-foot Equivalent Unit (TEU) boxes. The crew will be minimal and the vessel will be built to commercial American Bureau of Shipping (ABS) standards. Decrease of funding in FY 2005 was due to the completion of the High Speed Craft.

FY 2004 Accomplishments:

- Completed detail design of the LSC(X) prototype craft.
- Discontinued plans to install lifting body and drag reduction systems on the X-Craft following vessel delivery. Demonstration on these systems will be continued on an alternate platform.
- Completed scheduling and funding of crew training.
- Continue construction of the high speed vessel.

FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed above.
- Continue development of drag reduction and lifting body technology an alternative platform.
- Complete construction and deliver to fleet.
- Initiate and complete certification testing of the X-craft.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2912 PROJECT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY

FY 2007 Plans:

- Continue development of drag reduction and lifting body technology on an alternative platform.

C. OTHER PROGRAM FUNDING SUMMARY:
RELATED RDT&E:

NAVY RELATED RDT&E:
PE 0204152N (E-2 Squadrons)
PE 0205601N (HARM Improvement)
PE 0206313M (Marine Corps Communications Systems)
PE 0601153N (Defense Research Sciences)
PE 0602123N (Force Protection Applied Research)
PE 0602131M (Marine Corps Landing Force Technology)
PE 0602235N (Common Picture Applied Research)
PE 0602271N (RF Systems Applied Research)
PE 0603235N (Common Picture Advanced Technology)
PE 0603271N (RF Systems Advanced Technology)
PE 0603502N (Surface and Shallow Water Mine Countermeasures)
PE 0603561N (Advanced Submarine System Development)
PE 0603563N (Ship Concept Advanced Design)
PE 0603564N (Ship Preliminary Design and Feasibility Studies)
PE 0604307N (Surface Combatant Combat System Engineering)
PE 0603609N (Conventional Munitions)
PE 0603640M (USMC Advanced Technology Demonstration (ATD))
PE 0604518N (Combat Information Center Conversion)
PE 0604558N (New Design SSN)

NON NAVY RELATED RDT&E: Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R3049 PROJECT TITLE: FORCE PROTECTION

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R3049 FORCE PROTECTION	5,068	8,523	5,773	6,355	6,587	6,730	7,097	7,388

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. Demonstrate capabilities that 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. This project supports the Fleet/Force Protection FNC.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
EMERGING THREATS	5,068	8,523	5,773	6,355

This activity includes: Efforts in hull life assurance and distributed intelligence for automated survivability. It addresses the management of weapon effects to control structural damage and the improvement of structural materials. Prior to the funds provided by a program realignment for Force Protection, all efforts of this activity were tasks that had been previously funded in the Hull Mechanical and Electrical Activity of Project R2912. The program realignment for Force Protection adds funding beginning in FY 2006 that will be applied to the development of advanced technologies critical to protecting Naval Installations against terrorist threats and activities. Technologies developed will provide seamless full spectrum protection against asymmetric attack by improving the ability to: sense developing and immediate threats; shape our responses through improved situational awareness and decision making; shield personnel, mission critical facilities, infrastructure, and operating fleet assets; maintain essential functions; and sustain and restore critical services in the aftermath of an incident. Technologies developed will also seek to reduce the required manpower and skill levels devoted to the force protection mission.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R3049 PROJECT TITLE: FORCE PROTECTION

FY 2004 Accomplishments:

- Continue development of lower cost/higher performance Force Protection sensors and automated detection algorithms, and decision support tools.
- Completed small-scale tests of prototype optical sensor for volume sensing (fire and smoke detection).
- Completed small-scale testing of high efficiency water-mist system.
- Initiated testing of hybrid water-mist at an intermediate scale.
- Initiated development to increase the capability of previous volume sensor by extending capabilities to allow real-time response.
- Initiated collection of field data on real-time volume sensor.

FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed above.
- Complete development of real-time volume sensor.
- Complete intermediate-scale testing of hybrid water-mist system.
- Complete data collection and field test of volume sensor.
- Initiate validation of full scale ship test performance of the real-time volume sensor on ex-USS Shadwell.
- Initiate validation of full-scale ship performance trials of hybrid water-mist system on ex-USS Shadwell.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Initiate interim demonstration of prototype sensors.
- Initiate development of intrusion/incident response countermeasures.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R3049 PROJECT TITLE: FORCE PROTECTION

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.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

R2706	FY 2004	FY 2005
PROJECT M	4,805	1,882

FY 2004: Completed testing at sea of the Advanced Development Model (ADM) with the Look Ahead Detection System (LADS).

FY 2005: Based on at-sea testing in FY04 there are issues of robustness and reliability with the Look-Ahead Detection Sensors (LADS). In this fiscal year, improvements will be made to the LADS and an Engineering Development Model (EDM) of the shock mitigating seat will be fabricated, tested and delivered to SOCOM. (An EDM differs from an ADM in that it is more robust and can be considered the prototype of a model that can be manufactured in large quantities.) The EDM will operate as a semi-active system, not a totally active system.

R2711	FY 2004	FY 2005
SUPERCONDUCTING DC HOMOPOLAR MOTOR	5,391	3,666

FY 2004: Completed construction and initiated testing of the 3.7MW sub-scale motor, performed brush risk reduction, and began preliminary design of full scale propulsion motor.

FY 2005: Continue pursuing brush technologies that will allow the full scale motor to meet fleet application requirements. Continue design of the 36.5MW motor and power system.

R2828	FY 2004	FY 2005
ADVANCED WATERJET-21	1,944	0

FY 2004: Continued development of large scale demonstrator platform for signature, propulsion efficiency, and mechanical design interface evaluation.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R2831	FY 2004	FY 2005
AC SYNCHRONOUS HIGH TEMP SUPERCONDUCTOR (HTS) ELECTRIC MOTOR	5,783	3,467

FY 2004: Completed detailed design of 36.5 MW propulsion motor and motor drive, procured long lead material, and initiated manufacture.

FY 2005: Continue manufacture of 36.5MW motor. Complete fabrication of rotor, stator, and frame. Procure load device and begin test preparations.

R9013	FY 2004	FY 2005
LITTORAL SUPPORT CRAFT EXPERIMENTAL	13,452	9,906

FY 2004: Continued the construction of the X-Craft. Expected to be delivered in FY05, X-Craft will be built to evaluate the hydrodynamic performance, structural behavior, and propulsion system efficiency of high speed hull form technologies. The 79-meter all-aluminum craft will also be used to evaluate mission modularity through a large open mission bay and will eventually serve as a platform for LCS risk reduction.

FY 2005: Complete construction of LSC(X) (aka “X-Craft”) and deliver to fleet in May 2005. Install active rudder system to provide steering redundancy and increase directional stability. Install various “fleet ready” upgrades to allow use of vessel in fleet exercises in support of LCS risk reduction. Upgrades include damage control systems, C4I and shock-mitigating seats. Use any remaining funds to operate vessel through FY 2005 in support of LCS risk reduction.

R9014	FY 2004	FY 2005
PRECISION FABRICATION OF LARGE CURVED STEEL SHIP STRUCTURES	2,411	0

FY 2004: Developed 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 builds full-scale hull sections that may be used for air-blast and underwater explosion resistance testing. Performed air-blast and underwater explosion testing on precision welded sections and evaluated curved plate

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PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
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technology performance.

R9017	FY 2004	FY 2005
WIRELESS SENSOR NETWORK	961	0

FY 2004: Developed wireless sensor technology for monitoring all shipboard systems and provide situational awareness.

R9019	FY 2004	FY 2005
WAVE POWER DEMONSTRATION PROJECT	3,278	3,368

FY 2004: This effort provided for deployment of a second buoy to demonstrate methods of linking power produced by multiple buoys for transmission via one power cable.

FY 2005: This effort will explore more efficient methods of converting wave energy to electrical energy and develop an improved mooring system.

R9023	FY 2004	FY 2005
AFFORDABLE, INTERMEDIATE MODULUS COTS CARBON FIBER QUALIFICATION PROGRAM FOR AIRCRAFT AND MISSILES	0	991

FY 2005: Initiate the qualification of intermediate modulus carbon fibers for use in polymer reinforced composite components for applications in JSF and Global Hawk, JUCAV and the F18.

R9139	FY 2004	FY 2005
SANDWICH PANEL CONSTRUCTION	0	3,963

FY 2005: Initiate the execution of three primary project tasks 1) develop a prototype manufacturing system, incorporating breakthrough process control and quality assurance (PC/QA) technology that is capable of cost-effectively producing steel sandwich panels; 2) design a full manufacturing system capable of meeting the size, volume, quality and cost requirements of the US Navy; and 3) manufacture demonstration panels of the size and shape needed in order to qualify the product for the targeted platforms including the CVN 21 class

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

aircraft carriers.

R9140	FY 2004	FY 2005
HIGH SPEED PERMANENT MAGNET GENERATOR	3,460	6,438

FY 2004: Initiated design and construction of an approximately 3MW prototype high speed permanent magnet generator.

FY 2005: Continue design and construction of an approximately 3MW prototype high speed permanent magnet generator.

R9143	FY 2004	FY 2005
SMART SENSOR WEB ADVANCED TECHNOLOGY	0	1,784

FY 2005: Initiate efforts to develop and demonstrate an all digital interferometric signal detection and direction finder system.

R9293	FY 2004	FY 2005
VARICRAFT	0	6,241

FY 2005: This congressional add is a follow-on to FY 2004 High Speed, Heavy Lift Shallow Watercraft. The FY 2004 ($7.65M) was to develop a militarized design and construct a small-scale demonstrator of a variable draft advanced littoral transport. FY 2005 will produce a contract design for the vessel, procure long lead items relating to the propulsion plant, produce the integrated propulsion plant, and the complete detail construction design.

R9303	FY 2004	FY 2005
AGILE PORT AND HIGH SPEED SHIP TECHNOLOGY	4,826	4,953

FY 2004: Developed and demonstrated advanced maritime technologies with commercial and military applications. Includes scale model and full-scale demonstration of advanced hull forms, and supporting technologies in the areas of hydromechanics and lightweight structures.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

FY 2005: This plus-up funds a number of projects that deal with the application of transportation technologies to complementary Navy and civilian uses. Agile port efforts take the basic logistic cost estimates and arrangements derived from the FY 2004 effort and examine an alternative magnetic levitation technology to break the log jam between the port and an inland distribution center, or for military use between the depot and the port of embarkation. The fluid dynamic optimization synthesis design models will be selectively applied to a number of dual use multi-hull vessel candidate designs. Complete the concept design development of a very high power axial water jet design, tested at model scale in FY 2004. Further technical development efforts on the large trimaran will involve computational evaluations of the critical areas of hull form optimization, selected propulsion arrangements, and structural design issues involving regulatory approval.

R9303	FY 2004	FY 2005
STRATEGIC MOBILITY-21 DEPLOYMENT TECHNOLOGY	0	4,259

FY 2005: The Strategic Mobility-21 program is separately called out for FY 2005 but is a continuation of some FY 2004 work in Agile Port Technology. It will address the development and utilization of a candidate inland port facility (Victorville) operating in conjunction with controlled military and commercial cargo movement operations. The program will further involve both military and commercial port and terminal systems in the Southern California region and develop the supporting architectures for the comprehensive plan developed as part of the FY 2004 effort. The Strategic Mobility 21 program for FY 2005 is presently being further defined and drafted for approval and operational contracting in early 2005 in conjunction with an Operational Concept Document that is in development with USMC and USA guidance and related FY 2004 Agile Port funding.

R9304	FY 2004	FY 2005
AVIATION GROUND NAVIGATION SYSTEM (AGNAS)	1,636	991

FY 2004: Initiated the development of an integrated approach to planning and monitoring airside assets through the Aviation Ground Navigation System (AGNAS). If successful, AGNAS will provide an extremely precise depiction of airside personnel and ground support equipment locations, their movements, and a prediction of their future position.

FY 2005: Continue development and demonstration of the Aviation Ground Navigation System (AGNAS).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9305	FY 2004	FY 2005
COMPOSITE SPECIAL OPERATIONS CRAFT	964	0

FY 2004: Continued development of a replacement design for special operations craft that will incorporate composite hull construction technology and reduce slamming loads. Assembled the design and development team, confirmed basic requirements for the Mk V.1 prototype, began preliminary hull design, and began evaluation of candidate composite materials.

R9306	FY 2004	FY 2005
DOCK SHOCK	964	4,260

FY 2004: Continued development and system design studies for an advanced ship/platform shock test technology utilizing DARPA developed electrochemical explosive devices.
FY 2005: Demonstrate a suitable shock generation device and complete system engineering for a full scale test capability.

R9307	FY 2004	FY 2005
E-2C INFRARED SEARCH AND TRACK (IRST) TECHNOLOGY EXPERIMENTATION	1,325	0

FY 2004: Initiated infrared (IR) sensors on the E-2C aircraft for detection and tracking of Theater Ballistic Missiles (TBMs), as well as for aircraft and anti-aircraft missiles.

R9308	FY 2004	FY 2005
GLOBAL PERSONAL LOCATOR BEACON (PLB)	1,686	0

FY 2004: Developed Global Personal Location Beacon (PLB) Smart Sensor Web. This effort enhanced the current Emergency Positions Indicating Radio Beacons (EPIRBs) international constellation of satellites to relay an alerting distress message to a regional rescue coordination center (RCC) with critical situational data such as the nature of the emergency, what type of rescue will be required, number of people in the party, location, and condition of victims, and who should be alerted.

R9309	FY 2004	FY 2005

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9309	FY 2004	FY 2005
LARGE UNMANNED UNDERSEA VEHICLE (LUUV) TEST BED	1,154	1,684

FY 2004: This effort produced an integrated vehicle and guidance design for a Large Unmanned Undersea Vehicle (LUUV) Test Bed including the design of a water tunnel modification and test fixture for evaluating and validating distributed electrical propulsion concepts. Continued system concept development by conducting tradeoff designs of various vehicle sizes, shapes, architectures and propulsion options to best meet the program objectives. Continuing work will focus on the detailed design of the chosen system concept.

FY 2005: Initiate design modifications to the existing Large Unmanned Undersea Vehicle (UUV) Test Bed that will facilitate advanced UUV systems and scaled advanced submarine propulsion systems demonstrations. This will include development of a front end/controller interface architecture, modular section design concepts, vehicle handling equipment design, vehicle maneuvering and control design concepts, and land based testing of subsystems selected from the proposed design concepts.

R9310	FY 2004	FY 2005
LASER WELDING AND CUTTING	3,364	0

FY 2004: Continued to develop the automated laser process controls for T beam fabrication and develop a second generation or ‘beta’ prototype of an industrialized system design capable of producing beams for US Navy ships.

R9311	FY 2004	FY 2005
QUAD HULL SECURITY CAISSON TECHNICAL DEMONSTRATION	2,411	0

FY 2004: Constructed and evaluated a quad hull security caisson constructed from segmented curved plates (a proprietary structural design and manufacturing technology). The technology may offer a robust and economical means of protecting shore facilities and ships from sea based terrorist attack. Completed ballistic, air blast and underwater explosion testing on quad hull segments.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9312	FY 2004	FY 2005
REMOTE CONTINUOUS ENERGETIC MATERIAL MANUFACTURING PYROTECHNIC IR DECOYS	1,154	0

FY 2004: Initiated the development of a technology for safe, economical production of pyrotechnical material for use in DOD systems. The initial application will be in the manufacture of infrared decoy flares for use as countermeasures against heat-seeking missiles in order to protect US aircraft.

R9313	FY 2004	FY 2005
TECHNOLOGIES FOR FUTURE NAVAL CAPABILITIES	1,060	1,288

FY 2004: Developed a test-bed model of an unmanned surface vehicle to be employed in the development of control and monitoring algorithm. Systems integrations performed to ensure the viability of the models, simulations and signal processing.

FY 2005: Continue to develop realistic features to the test-bed model of the unmanned surface vehicle to be employed in the development of control and monitoring algorithm. Establish techniques to evaluate the performance and the viability of the models, simulations and signal processing.

R9314	FY 2004	FY 2005
WIRELESS PROGRAMMABLE LOGIC CONTROLLERS	964	0

FY 2004: Funds supported the incorporation of wireless technology into machinery monitoring and control devices for automated equipment and system operation.

R9344	FY 2004	FY 2005
EXTREME TERRAIN MEDICAL EVACUATION VEHICLE PILOT	0	1,684

FY 2005: Effort supports Extreme Terrain Medical Evacuation Vehicle Pilot.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9454	FY 2004	FY 2005
ADV DEV AND DEMO OF ELECTRIC ACTUATOR TECHNOLOGY	0	991

FY 2005: Efforts include testing, validating performance, and establishing the range of possible shipboard applications of a quarter-scale actuator.

R9455	FY 2004	FY 2005
AT-SEA DECONTAMINATION PLATFORM DEVELOPMENT AND CONCEPTUAL DESIGN	0	991

FY 2005: Initiate a feasibility assessment of potential advanced ship decontamination system designs that could be used while at-sea including the predicted decontamination success rates for various Chemical/Biological/Radiological Warfare constituents, anticipated costs for forward fit and backfit onto Navy ships, and development of an optimum system design for Navy ships.

R9456	FY 2004	FY 2005
BRAIDED REDUCED RECOIL ROPE FOR HAND AND MOORING LINES	0	991

FY 2005: Initiate testing to prove that a braided 12-strand Reduced Recoil Rope will meet or exceed performance requirements as specified by the Navy. Testing will include sequential break failure, coefficient of friction testing, torque and rotation testing and abrasion resistance testing.

R9457	FY 2004	FY 2005
COMPOSITE TWISTED RUDDER	0	991

FY 2005: Develop a composite twisted rudder and start initial qualification tests. This rudder will have a non-uniform cord shape optimized to minimize the angle of attack of the water flow, thereby minimizing cavitation. The composite rudder will not corrode, will be lighter and easier to fabricate, and may have lower lifecycle cost.

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PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9458	FY 2004	FY 2005
DEPLOYABLE FIBER OPTIC FORCE PROTECTION SYSTEM	0	1,784

FY 2005: Initiate optimized 3D underwater hydrophone tracking algorithms and demonstrate deployable fiber optic force protection system.

R9459	FY 2004	FY 2005
DEVELOPMENT OF WIDE BANDGAP SEMICONDUCTOR MATERIALS	0	4,457

FY 2005: Initiate development of semiconductor materials capable of higher power levels and greater temperature ranges than currently employed silicon-based materials.

R9461	FY 2004	FY 2005
ELECTROMAGNETIC PROPULSION COST REDUCTION	0	1,388

FY 2005: Initiate efforts to identify dual use technologies to reduce the cost of military and civilian applications of linear motor systems.

R9462	FY 2004	FY 2005
FUTURE NAVAL CAPABILITIES - CREW MODELING AND SIMULATION (FNC-CMS)	0	2,576

FY 2005: Initiate efforts to develop, validate and verify crew modeling and simulation that can be used as part of the Navy ship system design. This provides for a robust capability to determine the tactical and maintenance workload changes associated with new systems and significant systems changes.

R9463	FY 2004	FY 2005
HIGH-SPEED POWER NODE SWITCHING CENTER	0	1,388

FY 2005: Initiate design and fabrication of a high-speed switching center based on state-of-the-art technology for shipboard applications.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9464	FY 2004	FY 2005
INTEGRATED ADVANCED COMMUNICATIONS TERMINAL (ACT)	0	991

FY 2005: Initiate efforts to develop the design and interface methodology to enable advanced integration of a variety of communications terminal architectures. This alleviates the necessity for duplicative common communication terminal components.

R9465	FY 2004	FY 2005
MISSILE WARNING SENSOR	0	2,477

FY 2005: Develop 2-color mid-wave infrared (MWIR) sensor technology for improved missile warning receiver (MWR) performance over current systems operating in the ultraviolet (UV). Specific efforts will address fabricating mercury-cadmium-telluride (MCT) focal plane arrays in a 2-color, stacked diode, 256-by-256 pixel architecture on 6-inch silicon wafer substrates for greatly improved affordability; and developing a common sensor design to include visible and near-infrared (Vis/NIR) pulsed laser guidance detection along with 2-color MWIR missile plume detection in a single threat warning receiver, greatly reducing the cost and logistics burden of separate receivers.

R9466	FY 2004	FY 2005
MULTI-MISSION WARHEAD FOR ULTRA-LIGHT TORPEDO	0	2,279

FY 2005: Initiate investigation, by analysis and full scale experiments. To determine the effects on performance of combining defensive (omnidirectional) and offensive (directed energy) warhead technologies into a single multimode warhead for the 6.75" torpedo.

R9467	FY 2004	FY 2005
NON-LINE OF SIGHT (NLOS) FOR UNMANNED SYSTEMS	0	4,260

FY 2005: Initiate modifications to hardware prototypes for the Omni-Directional Inspection System (ODIS), which provides an electronically transmitted view of the underside of a vehicle. Each ODIS is composed of a high-resolution camera mounted on a sophisticated, omni-directional mobile platform that transmits video back to an Operator. This system can potentially reduce the risk to Military Police in screening vehicular traffic

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603123N PROGRAM ELEMENT TITLE: FORCE PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

into secure areas.

R9468	FY 2004	FY 2005
DEVELOPMENT OF SULFER TOLERANT COPPER-BASED SOLID OXIDE FUEL CELL (SOFC)	0	991

FY 2005: Conduct research to investigate sulfur tolerant copper-based anode catalyst materials for solid oxide fuel cells for future Navy applications. This includes test fixture fabrication, anode cell materials development, and associated testing.

R9469	FY 2004	FY 2005
TADIRCM ANTIMISSILE TECHNOLOGY	0	6,736

FY 2005: Develop advanced component technologies for the Tactical Aircraft Directed Infrared Countermeasures (TADIRCM) Early Operational Analysis (EOA) pod effort. These include: (a) high power, multi-band mid-wave infrared (MWIR) lasers with improved beam quality, beam stability, efficiency and output power that can operate at the elevated temperatures and high-G/high vibration environment of a tactical jet pod installation; (b) MWIR transmitting fiber optics to improve coupling of the multi-band laser to the jam head beam director, (c) low profile, light weight, shared-axis fine trackers and beam directors with reduced pointing jitter and advanced auto-bore-sight capability that are suitable for high-G/high vibration operation; and (d) advanced missile warning receivers with low-cost fully athermalized and achromatic optics and advanced processing algorithms for rapidly geo-locating surface-to-air missile launch sites.

R9470	FY 2004	FY 2005
UNMANNED FORCE AUGMENTATION SYSTEM	0	991

FY 2005: Initiate efforts to conduct research, development and testing of advanced unmanned aerial vehicle (UAV) technologies, including the design and integration of an avionics suite and flight demonstration of the system. If successful, this effort will provide the Navy with a much-improved shipboard landing capability for fixed wing unmanned aircraft.

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R9471	FY 2004	FY 2005
UNMANNED SYSTEMS TECHNOLOGIES FOR EXPLOSIVE ORDNANCE DISPOSAL	0	4,260

FY 2005: Initiate development of S&T tools and capabilities necessary for the military and law enforcement Explosive Ordnance Disposal (EOD) technicians to meet the various EOD, Improvised Explosive Device (IED), and Unexploded Ordnance (UXO) challenges and reduce the risk to the personnel by developing unmanned systems to perform these dangerous and critical missions.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N
PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	83,556	83,062	60,589	53,471	31,101	45,149	50,752	70,955
R2919	COMMUNICATIONS SECURITY							
	72,599	78,703	60,589	53,471	31,101	45,149	50,752	70,955
R9020	VESSEL TRACKING							
	4,228	0	0	0	0	0	0	0
R9315	CONSOLIDATED UNDERSEA SITUATIONAL AWARENESS SYSTEM (CUSAS)							
	3,844	3,368	0	0	0	0	0	0
R9316	SHIPBOARD AUTOMATED RECONSTRUCTION CAPABILITY (SHARC)							
	1,924	0	0	0	0	0	0	0
R9317	TECHNOLOGY INSERTION SUPPORT							
	961	0	0	0	0	0	0	0
R9472	DYNAMIC BROKERING IN THE EXPEDITIONARY WARFARE TESTBED							
	0	991	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) addresses the advanced technology development, test and evaluation of a dynamic distributed common picture that will improve situational awareness across command echelons. The goal is to refine technologies that exploit information and networking technology to ensure mission success in an unpredictable warfighting environment. It creates network centric capability by demonstrating technologies that support seamless information services afloat and ashore; collaborative decision-making among geographically dispersed warfighters; a common, consistent view of the battlespace geared to user requirements; system interoperability with coalition forces; real-time information access with quality of service guarantees; and information assurance. Technologies of interest provide access to, and automated processing of, information necessary to make decisions that lead to decisive, precise, desired engagement outcomes. The payoff is access to tailored information in near real time with

BUDGET ACTIVITY: 03
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corresponding increases in speed of command, improved decision-making, and reduction in manpower. The Common Picture Program supports the Knowledge Superiority and Assurance (KSA), Missile Defense (MD), and Fleet/Force Protection (FFP) Future Naval Capabilities (FNC). In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet, “Persistent Intelligence, Surveillance, and Reconnaissance,” “Time-Sensitive Strike,” “Sea-Based Information Operations,” “Sea Strike” Ship-to-Objective Maneuver, and “Sea Shield” Theater Air and Missile Defense.

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

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N
PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	79,690	79,521	62,624	60,080
Cong Rescissions/Adjustments/Undist. Reductions	0	-842	0	0
Congressional Action	0	4,400	0	0
Execution Adjustments	6,202	0	0	0
FNC Realignment	0	0	-13,780	-16,796
Non-Pay Inflation Adjustments	-74	0	0	0
Program Adjustments	0	-17	-59	-45
Program Realignment	0	0	11,774	10,051
Rate Adjustments	0	0	30	181
SBIR Assessment	-2,262	0	0	0
FY 2006/2007 President's Budget Submission	83,556	83,062	60,589	53,471

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2919 PROJECT TITLE: COMMUNICATIONS SECURITY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R2919 COMMUNICATIONS SECURITY	72,599	78,703	60,589	53,471	31,101	45,149	50,752	70,955

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This project addresses the advanced technology development, test and evaluation of a dynamic distributed common picture based on emergent technologies that will improve situational awareness across command echelons. The goal is to refine technologies that exploit information and networking technology to ensure mission success in an unpredictable warfighting environment. It creates network centric capability by demonstrating technologies that support seamless information services afloat and ashore; collaborative decision-making among geographically dispersed warfighters; a common, consistent view of the battlespace geared to user requirements; system interoperability with coalition forces; real-time information access with quality of service guarantees; and information assurance. Technologies of interest provide access to, and automated processing of, information necessary to make decisions that lead to decisive, precise, desired engagement outcomes. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower. In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet, “Persistent Intelligence, Surveillance, and Reconnaissance,” “Time Sensitive Strike,” “Sea Based Information Operations,” “Sea Strike” Ship-to-Objective Maneuver, and “Sea Shield” Theater Air and Missile Defense.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2919 PROJECT TITLE: COMMUNICATIONS SECURITY

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
KNOWLEDGE SUPERIORITY AND ASSURANCE (KSA)	25,642	43,594	31,944	29,275

Knowledge, Superiority, and Assurance (KSA) explores fundamental technologies that enhance the Navy's capability to exploit, manage, and integrate complex, heterogeneous, multi-source information for the next generation common picture. Science and Technology (S&T) work is being focused on Navy and Marine Corps Warfighter Capability Gaps identified through analysis of operational and exercise lessons learned, as well as campaign analysis of capabilities required in the 2010-2015 time frame. Warfighter Capability Gaps being addressed by FORCEnet S&T needs include Combat Identification (CID), Ubiquitous Communications (Comm), Computer and Network Defense and Information Assurance (CND&IA). Office of Naval Research (ONR) has established groupings of S&T Projects to incrementally provide technology input to eliminate Warfighter Gaps: these are called Enabling Capabilities (EC). Each EC delivers capability-level product to acquisition in a three to five year effort, and allocates a sufficient investment to ensure a capability is provided. For example, ID EC-1A provides cryptologic management and level one fusion capability in a Global Information Grid-compliant implementation, and transitions to the warfighter in FY05. Ubiquitous Communications provides Dynamically Managed, Interoperable, High-Capacity Connectivity wireless network technology critical to the performance and robustness of naval communications by providing higher data rates, expanded coverage to disadvantaged platforms, and improved bandwidth management.

The increase in FY 05 funding is due primarily to shift of work on K/Ka/Q-band phased array antennas from PE0603271N.

FY 2004 Accomplishments:

• Continued demonstrations of the Multi-National Virtual Operation Network (MNVOC) between UK and US. Initiated development of software and system certification of secure web servers to share tactical multiple media data products with coalition forces.
• Continued development of the Airborne Communication Payload for the Firescout Unmanned Aerial Vehicle (UAV). Completed initial laboratory demonstration and initiated planning for FY 05 Airborne Flight Testing.
• Continued Battle Force Networking (Block II) and Wireless Quality of Service (QoS) Based Routing for FORCEnet.
• Completed transition for Traffic Flow Engineering to PMW179 Automated Digital Networking System (ADNS).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
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• Completed transition for Real-Time Execution Decision Suite (REDS) to PMA-281 Joint Mission Planning System (JMPS).
• Completed transition for Image Processing and Exploitation Architecture (IPEX) to PMA-281 Joint Services Image Processing System - Navy (JSIPS-N).
• Completed transition for Land Attack Control Suite (LACS) to PMA-282 Tactical Tomahawk Weapon Control System (TTWCS).
• Completed transition for Integrated Decision Support Suite (IDSS) to Special Operations Command Program Manager Special Operations Mission Planning Environment (SOMPE).
• Completed transition of distributed collaborative planning and execution tools to support the Commander In Chief Twenty-First Century Advanced Concept Technology Demonstration (CINC 21 ACTD).
• Completed transition for Dynamic Reconfiguration of Link 16 (PMW-159).
• Initiated effort for Comprehensive, Analytic, Real-Time Execution in Joint Air Operations (CARTE).
• Initiated effort for Wireless Quality of Service Based Routing for FORCEnet.

FY 2005 Plans:

• Continue all efforts of FY 04 less those noted as completed above.
• Complete work on K/Ka/Q-band phased array antennas for submarine, ship, and mobile ground vehicles. (Previously funded in PE 0603271N).
• Complete work on Battle Force Composite Networking Block II and Wireless Quality of Service (QoS) Based Routing for FORCEnet and transition to ADNS (PMW 160).
• Conduct Sea Trial Experimentation on capability to access, update, and maintain the Common Operational and Tactical Picture (COTP) through an integrated and interoperable set of software applications.
• Conduct Sea Trial Experimentation on the Multi-National Virtual Operations Capability (MNVOC) Battle Force Email High Frequency (HF) Local Area Network system to carry Internet Protocol (IP) data over HF (and other Line of Site Systems) to complement satellite communications assets.
• Initiate effort for Reconfigurable Surveillance UAVs for Warfighter Protection. (Moves to PE 0603114 in FY 06).
• Initiate Joint Coordinated Real-Time Engagement (JCRE) Advance Concepts Technology Demonstration (ACTD) to provide Global Information Grid (GIG)-compliant core enterprise Services and Community of Interest (COI) Services which ensure warfighting COIs access to information required from any source for rapid situation awareness assessment.
• Initiate effort for Decision Support for Dynamic Target Engagement.
• Initiate Information Assurance effort called Secure Distributed Collaboration.

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• Initiate effort on Integrated Autonomous Network Management (IANM).
• Initiate an Ultra-High Frequency (UHF)/L-Band Phased Array Antenna for Naval aircraft carrier platforms. (Moves to PE 0603271N in FY06).

FY 2006 Plans:

• Continue all efforts of FY 05 less those noted as completed above.
• Complete transition of MNVOC.
• Complete Intra Battlegroup Wireless Networking (Block II).
• Complete Airborne Communications Package(ACP).
• Initiate effort on Processing Tactical Signal Intelligence (SIGINT) (Sly Fox) (follow on to Tactical Processing and Analysis from PE 0602235N).
• Initiate Actionable Information from Multiple Intel Sources in a GIG-Electronic Surveillance (ES) Environment.
• Conduct Sea Trial Experimentation of command decision-making and dynamically managed connectivity (e.g., Decision Support for Dynamic Target Engagement; Secure Distributed Collaboration; Processing Tactical SIGINT, Integrated Autonomous Network Management (IANM); as well as replanning and rehearsals of operational and tactical forces.)

FY 2007 Plans:

• Continue all efforts of FY 06 less those noted as completed above.
• Complete development of Secure, Distributed Collaboration.
• Complete development of Integrated Autonomous Network Management.
• Initiate effort for Improved Maritime COTP in a GIG-ES Environment.
• Conduct Sea Trial Experimentation of command decision-making and dynamically managed connectivity (e.g., Decision Support for Dynamic Target Engagement; Secure, Distributed, Collaboration; Processing Tactical SIGINT, Integrated Autonomous Networking; as well as replanning and rehearsals of operational and tactical forces.
• Conduct additional Joint Limited Technology Experiment to demonstrate JCRE in the GIG environment, enabling coordination and application of strike assets in real time.

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	FY 2004	FY 2005	FY 2006	FY 2007
USCG VESSEL TRACKING	9,970	10,560	4,848	4,862

Details are of a higher classification.

	FY 2004	FY 2005	FY 2006	FY 2007
MULTI-SOURCE INTEGRATION (MSI) AND COMBAT IDENTIFICATION (CID)	4,809	9,031	8,796	8,421

Multi-Source Integration (MSI), Advanced Sensor Netting Technology (ASNT) and Composite Combat Identification (CCID) technology of the Missile Defense Future Naval Capability (FNC) address theater air and missile defense (TAMD) needs for data fusion, correlation of and reasoning over attributes leading to target Identification, and sensor fusion/management. The goal is to develop algorithms for use by air defense combat systems which will then be able to fuse, filter, and correlate on-board sensor and off-board battlespace information from all sources to achieve one common Combat Identification (CID) solution using Theater-wide information. This activity includes support to the FNC Enabling Capabilities for Real Time Long Range Air Defense Combat ID in Support of Early Engagements (KSA EC-1B).

FY 2004 to FY 2005 increase is due primarily to the effects of the FY 2004 transitioning of MSI and Advanced Sensor Netting Technology (ASNT) into this PE.

FY 2004 Accomplishments:

• Demonstration of an early version of advanced MSI algorithms begun in FY 2003 in PE 0602235N to integrate radio frequency (RF) sensors, Identification Friend or Foe (IFF) data, Cooperative Engagement Capability (CEC), Joint Tactical Information Distribution System (JTIDS), and correlate Satellite Communications (SATCOM) data to the integrated track file in the E-2C airborne early warning aircraft mission computer. Selected best performing of three candidate MSI algorithms for further development & testing.
• Demonstrated evolution of algorithms within the Advanced Sensor Netting Technology (ASNT) project initially developed under PE 0602235N. These algorithms are designed for integration of electronic warfare support (ES) data into CEC and transmission of track ID attributes via CEC-like network.
• Transitioned CCID algorithms to PMA-290 for use within the EP-3E aircraft. These algorithms are designed to correlate and fuse real time track data with intelligence, surveillance and reconnaissance (ISR) data processed aboard EP-3E reconnaissance aircraft. Continued development of similar CCID algorithms in Ship

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Signal Exploitation Equipment (SSEE)-equipped surface ships. Continued evolutionary development of a common reasoning algorithm for CID capability to rapidly building high confidence identification of air tracks using all available ID attributes in theater.

FY 2005 Plans:

• Continue all efforts of FY 04 less those noted as completed above.
• Deliver most recent versions of MSI, ASNT, and CCID algorithms to the Joint Single Integrated Air Picture (SIAP) Systems Engineering Organization Integrated Architecture Behavior Model for use in joint service open architecture combat system applications with plan to continue deliveries in FY06 and FY07.

FY 2006 Plans:

• Continue all efforts of FY 05 less those noted as completed above.

FY 2007 Plans:

• Continue all efforts of FY 06 less those noted as completed above.

	FY 2004	FY 2005	FY 2006	FY 2007
PLATFORM PROTECTION/ELECTRONIC WARFARE SYSTEMS	8,714	7,466	7,215	3,103

This activity supports the Fleet/Force Protection (FFP) Future Naval Capability (FNC). Currently, small surface, ground-based and airborne platforms have limited Situational Awareness (SA) capability, which jeopardizes their battlefield effectiveness and combat survivability. This activity develops the Electronic Warfare Integrated System for Small Platforms (EWISSP), a compact small platform electronic warfare capability providing radio frequency (RF), electro-optic (EO) and infrared (IR) sensors for platforms such as smaller ships, expeditionary fighting vehicles (EFV), and surveillance aircraft. This activity integrates successful proof-of-concept hardware and software developed under PE 0602235N into systems suitable for capability demonstration under Naval environments and tactical conditions. Responding to customer reprioritization of requirements based upon threat capabilities, the initial focus of the EWISSP program will be toward the development of an EO/IR detection, warning, and countermeasures capability with future capabilities development in the RF technology area. This activity includes support to the FNC Capability for Hostile Fire Detection and Response Spiral 1 (U/A OPS EC 1C).

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Decrease is due to the EWISSP program completing in FY 2007.

FY 2004 Accomplishments:

• Continued the development of advanced technology applications to increase the survivability of the Marine EFV.
• Continued development of the EO countermeasures subsystem.
• Continued testing prototype flexible masts for EO countermeasures sensors in parallel with compatibility testing with existing and/or planned basic physical and electrical designs and features of the EFV platform.
• Continued integration of the EWISSP with the EFV to address issues related to limited space and power available in the EFV as well as severe restrictions on modifications to the vehicle's exterior configuration.

FY 2005 Plans:

Continue all efforts of FY04 less those noted as completed above.
• Initiate assembly and integration of the Situational Awareness (SA) and Electronic Attack (EA) subsystems. Focus will be on hardware and software integration at the subsystem level.
• Initiate incremental testing of subsystems as they are assembled to ensure technical performance requirements are being met.
• Initiate implementation of design configuration management as part of the transition effort to track development and integration progress and identify technology insertion points.

FY 2006 Plans:

Continue all efforts of FY05 less those noted as completed above.
• Complete fabrication and test of EWISSP subsystems. Integrate subsystems into EWISSP prototype systems for final demonstrations and test.
• Initiate EWISSP IR Threat Warning System (IR TWS) Operational Demonstration – Show capability of the IR TWS to detect simulated missiles in a field environment, including evaluation of response time, azimuth and elevation accuracy, and false alarm rate.
• Initiate field demo of integrated system on surrogate vehicle (High Mobility Multi-purpose Wheeled Vehicle (HMMWV)), to demonstrate EO/IR sensor detection and cueing of laser decoy, Multi-function Electro Optical System (MEOS) countermeasures, and optical augmentation for situational awareness and target detection and ID.

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FY 2007 Plans:

• Continue all efforts of FY06 less those noted as completed above.
• Complete final demonstration of EWISSP system installed on EFV in operational realistic environment to show increased EFV survivability against advanced EO/IR threats.

	FY 2004	FY 2005	FY 2006	FY 2007
GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY	5,303	5,144	4,848	4,862

This activity enhances GPS anti-jam (AJ) capabilities and develops other technologies to provide alternative navigation methods. In the GPS AJ area, Space-Time Adaptive Processing (STAP) is being pursued to remove the operational risks associated with enemy jamming of GPS functions. Also, the next generation GPS receiver will be programmed with M-code; therefore, both the next generation M-code and the existing C/Y-codes must be used at the same time frame. Office of Naval Research (ONR) initiated a transitional receiver which will accommodate both the C/Y- and M-codes. The alternative navigation methods investigated include GPS receivers with a tightly coupled Inertial Navigation System (INS); organic Link-16 relative navigation; gravity gradiometer development, used in a terrain-following concept; and an electro-optic accelerometer developed as an improved element in INS. This activity also develops the atomic clock for inclusion in Naval Systems. The atomic clock efforts include small, low-cost Rubidium (Rb), Coherent Population Trapping (CPT) atomic clock development. These areas will provide alternatives to GPS navigation and alternatives to the availability of precision, GPS-provided, time transfer.

FY 2004 Accomplishments:

• Completed a feasibility study on the Vibrating Beam Gradiometer which could detect the gravity with the sensitivity of 100 pG based on the principle of a quartz vibrating beam accelerometer.
• Completed Link-16 Relative Navigation with corrections to latencies in precision time transfer.
• Continued the development of a 7-element Space-Time Array Processor (STAP) brassboard and successfully integrated and tested in the lab. Also developed 15-Channel STAP brassboard and fabricated 15-channel STAP.
• Continued the development of a GPS-III receiver that can acquire new M-code directly using a Frequency Hopping (FH) search technique. Designed and built the GPS-III software receiver by Field Programmable Gate Array (FPGA) that can adapt to “near-far” reception in real time operation.
• Continued the development of a GPS receiver both GPS M- and C/Y-codes that could be operated using both M- and C/Y-codes in a single unit with a minimum disruption for Navy users.

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• Continued the development of a small, lightweight Micro-Electro-Mechanical Systems (MEMS) accelerometer for navigation systems; an Electro-optic Accelerometer is fabricated.
• Continued the development of a 10cc Rb Coherent Population Trapping (CPT) atomic clock for tactical applications.
• Continued the development of an Adaptive Bathymetric Estimator, which estimates errors in sound speed profile by only own-ship and historical data; and correct bottom contact track positions for errors due to both assumed sound speed profile mismatch and own-ship position measurement drift.
• Continued the development of algorithms for distributed time scaling other supporting scaling; developed architectures necessary to establish a Navy Global Coordinated Time Scale; tested the algorithms via both simulation and using actual clock data provided by the U.S. Naval Observatory (USNO).

FY 2005 Plans:

• Continue all efforts of FY04 less those noted as completed above.
• Complete the integration of the Frequency Hopping (FH) M-code correlator, data recorder and Field Programmable Gated Array (FPGA) GPS software receiver card; conduct fast M-code acquisition tests.
• Initiate the development of an Optical Ring Gyroscope Chip; Fabricate dual-arm, 2 cm diameter, optical ring resonator in neodymium-doped substrates; incorporate an electro-optics phase modulator into the ring.
• Initiate the demonstration project of nonlinearity-constrained adaptive beamforming for defeating BPSK jammers; develop an algorithm to mitigate the loss of Signal-to-Noise Ratio (SNR) through a combination of adaptive space-time-frequency signal processing techniques.

FY 2006 Plans:

• Continue all efforts of FY05 less those noted as completed above.
• Complete the fabrication of an Applications Specific Integrated Circuit (ASIC) chip for GPS M- and C/Y-code and test with GPS II and GPS III signals
• Initiate the development of two gravity gradient devices; the first is an Octadecahedral Gravity Gradiometer in which the full-Gravity Gradient tensor is determined to separate translational and rotational effects from gravity effects; the second is a Ribbon Sensor Gravity Gradiometer whose vibrational modes in a gravitational field can be related to the gravity gradient tensor elements.

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• Initiate the development of a magnetic map requirements for Magnetic Passive Navigation (MPN); top-level MPN performance requirements, establishment of the MPN reset algorithm, development of system hardware requirements, investigation of existing magnetic maps and models, developing map and modeling requirements, determining risk areas, evaluating performance projections, and preparing a final report.

FY 2007 Plans:

• Continue all efforts of FY06 less those noted as completed above.
• Integrate the 5-cc accelerometer with the Embedded GPS Inertial (EGI) System for aircraft avionics applications.

	FY 2004	FY 2005	FY 2006	FY 2007
INFORMATION SECURITY RESEARCH	2,119	1,918	1,938	1,945

The goal of this activity is to protect the Navy and Joint information infrastructure from hostile exploitation and attack. This requires situational awareness of network assets and operations. This activity focuses, in part, on integrating successful proof-of-concept research prototypes developed under PE 0602235N. The goal is to develop tools, techniques and methodologies in order to: improve network resistance to denial of service attacks; improve indications and warnings of suspect activities; conduct traffic analysis; monitor and assess network status and health; identify new capabilities to analyze and network vulnerabilities and attacks; measure the effectiveness of Information Assurance (IA) protective measures; and improve the quality and level of certification of IA software.

FY 2004 Accomplishments:

• Developed and validated secure group network protocols within a small enclave, as well as developed 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.
• Continued to examine the tools, techniques, and methodologies that ensure secure network survivability and resistance to denial of service attacks.
• Continued development of the Naval Research Laboratory (NRL) Network Pump, including development of methodologies to securely transfer data from a higher to lower level of classification, including stronger connection authentication and secure administration capabilities.

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FY 2005 Plans:

• Continue all efforts of FY04 less those noted as completed above.
• Complete development, demonstration, and common criteria evaluation of the NRL Network Pump for its ability to transfer data securely from high to lower levels of classification across dissimilar networks while providing strong authentication and secure administration capabilities.
• Initiate development of a secure, survivable, and dynamic service-oriented enterprise architecture to support military missions, addressing grid computing, peer-to-peer computing, and the adaptation of security and survivability features to those technologies for military use.

FY 2006 Plans:

• Continue all efforts of FY05 less those noted as completed above.
• Complete the development and demonstrate correlated statistical analysis of pro-active monitoring of intrusive network behaviors, specifically addressing network misuse at the lowest/slowest event level (e.g., low bandwidth, high timeline events).
• Initiate development of the security management tool that provides a common picture of the networked environment with respect to information assurance and security, with emphasis on visualization capabilities to support active computer network defense.
• Initiate development of a tool for the development of agents that integrates unified modeling language (UML) and that provides a verifiable agent programming language, an inter-agent communication protocol, security agents for enforcing run-time properties, and property checkers.

FY 2007 Plans:

• Continue all efforts of FY06 less those noted as completed above.
• Complete the development and demonstrate a secure, survivable, and dynamic service-oriented enterprise architecture to support military missions, addressing grid computing, peer-to-peer computing, and the adaptation of security and survivability features to those technologies for military use.

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	FY 2004	FY 2005	FY 2006	FY 2007
MARINE MAMMALS	1,093	990	1,000	1,003

This initiative provides data and technology for making informed decisions regarding the interaction of Naval activities with protected marine life and habitats to enable platform operation and force projection, and maximize use of Navy training ranges within environmental constraints. Ensure Navy compliance with national environmental laws, Executive Order 12114, and SECNAVINST 5090.1.b while still maintaining full operational and training exercise capabilities.

FY 2004 Accomplishments:

• Integrated passive acoustic marine mammal monitoring (M3R) tracking technology at the Atlantic Undersea Test and Evaluation Center (AUTEC); collected M3R data at the Pacific Missile Range Facility (PMRF) to calibrate passive technology with visual surveys; proposed use of M3R technology to N45 as mitigation measure in the Navy range wide tactical theater training assessment planning (TAP) FY04-FY09.
• Initiated temporary threshold shift (TTS) data collection to determine time/energy trade-off and recovery rates for long duration sound exposures and multiple pings typical of Navy operations and training.

FY 2005 Plans:

• Continue all efforts of FY04 less those noted as completed above.
• Expand M3R frequency bandwidth for tracking beaked whales. Develop classification software for identification of marine mammal species and populations. Continue AUTEC on-site analysis and PMRF data collection with visual surveys. Begin Technology Readiness Level (TRL) assessment and transition plan.

FY 2006 Plans:

• Continue all efforts of FY05 less those noted as completed above.
• Test M3R classification software for identification of species and populations, and complete M3R development at AUTEC. Continue data collection at PMRF with visual surveys. Complete TRL and transition plan with N45 and develop technology transition agreement (TTA).
• Complete TTS data collection and formulate an Acoustic Safety Criteria Model for multiple sonar pings.
• Complete model for equal loudness.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
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FY 2007 Plans:

• Continue all efforts of FY06 less those noted as completed above.
• Incorporate M3R classification software for identification of species and populations at PMRF. Begin implementation of transition plan for demonstration and evaluation of M3R technology at other Navy ranges.
• Establish Acoustic Safety Criteria Model for multiple sonar pings. Transition from behavioral to electrophysical measurements to assess hearing and TTS of non-captive marine mammal species.

	FY 2004	FY 2005	FY 2006	FY 2007
JOINT PROGRAM OFFICE SPECIAL TECHNOLOGY COUNTERMEASURES	14,949	0	0	0

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)

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NON-NAVY RELATED RDT&E:

PE 0603750D8Z (Advanced Concept Technology Demonstrations)

D. ACQUISITION STRATEGY:
Not applicable.

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PROGRAM ELEMENT: 0603235N PROGRAM ELEMENT TITLE: COMMON PICTURE ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

R9020	FY 2004	FY 2005
VESSEL TRACKING	4,228	0

This effort determined and developed the optimum technology mix for identification, surveillance, and tracking of maritime vessels. This effort developed high resolution radar techniques from multiple aspects to verify and validate automated information system data fields. This effort emphasized small craft tracking and automatic target recognition which are essential Naval needs for operations in the littorals and harbor areas.

R9315	FY 2004	FY 2005
CONSOLIDATED UNDERSEA SITUATIONAL AWARENESS SYSTEM (CUSAS)	3,844	3,368

FY04 - This effort provided knowledge superiority to undersea warfare forces through the use of advanced, interactive information management software. The effort developed high-fidelity 2D and 3D presentation augmented with real-time tactical intelligence agent-based recommendations in a user-friendly format. It used intelligent software agents that provide timely, effective, and efficient decision support under conditions of overwhelming and uncertain data. In particular, it provided an accurate and timely situational understanding of the battlespace by a submerged submarine. Accomplishments include initial software development and transition to PEO-IWS

FY05 - This effort will continue development of the openly-architected agent-based decision support software for the Undersea Warfare Decision Support System and the Aircraft Carrier Tactical Support Center. The deliverable will be an agent-based software module for the ASW Combat, Command, and Control System.

R9316	FY 2004	FY 2005
SHIPBOARD AUTOMATED RECONSTRUCTION CAPABILITY (SHARC)	1,924	0

This effort assisted submarine operators with planning, executing and evaluating highly complex tactical and covert submarine missions. This effort captured and dynamically presented all relevant operational data, as well as the Commanding Officer's narrative. This automatic data capture and visual replay allowed a

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submarine's commander and crew to accurately reconstruct high interest events experienced during the mission. This system greatly enhanced continuous operational improvement through reviewing and critiquing previous missions. Accomplishments include initial software development and transition to the Virginia Class submarine and PEO-IWS 5.

R9317	FY 2004	FY 2005
TECHNOLOGY INSERTION SUPPORT	961	0

This effort investigated new information technologies which required testing and evaluation of applications throughout the Joint services.

R9472	FY 2004	FY 2005
DYNAMIC BROKERING IN THE EXPEDITIONARY WARFARE TESTBED	0	991

This effort will develop dynamic brokering capabilities in the expeditionary warfare testbed for refining the discovery process of the service-based architecture to support faster performance, better communications throughput usage, and the underpinnings of multi-level security to support user requirements. The open service-based Expeditionary Warfare Testbed architecture supports the inclusion of new web services. Scalability and usability dictate minimizing redundancy while maintaining quality of service.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	87,281	91,665	68,540	82,623	85,106	83,288	74,450	116,141
R2915	WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY							
	54,250	58,974	68,540	82,623	85,106	83,288	74,450	116,141
R9014	PRECISION FABRICATION OF LARGE CURVED STEEL NAVY SHIP STRUCTURES							
	0	1,981	0	0	0	0	0	0
R9021	LOW VOLUME PRODUCTIVITY							
	0	1,485	0	0	0	0	0	0
R9023	INTERMEDIATE MODULUS COTS CARBON FIBER QUALIFICATION							
	1,921	0	0	0	0	0	0	0
R9147	DEFENSE MODERNIZATION AND SUSTAINMENT INITIATIVE							
	1,932	3,963	0	0	0	0	0	0
R9148	EMERGING/CRITICAL INTERCONNECTION TECHNOLOGIES PROGRAM (E/CIT)							
	3,363	0	0	0	0	0	0	0
R9149	ENERGY AND ENVIRONMENTAL TECHNOLOGY							
	4,112	0	0	0	0	0	0	0
R9150	INTEGRATED VEHICLE HEALTH MANAGEMENT SYSTEM							
	4,025	2,576	0	0	0	0	0	0
R9151	CAFFING PROTECTION SYSTEM							
	0	1,388	0	0	0	0	0	0
R9318	AUTOGEN							
	2,887	0	0	0	0	0	0	0
R9319	AUTOMATIC CONTAINER AND CARGO HANDLING SYSTEMS							
	1,937	1,981	0	0	0	0	0	0

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

R9320	EXPEDITIONARY LOGISTICS FOR THE 21ST CENTURY (EXLOG21)							
	964	2,972	0	0	0	0	0	0
R9321	EXTREME ENVIRONMENT URBAN WARFARE RESEARCH							
	3,411	0	0	0	0	0	0	0
R9323	HUMAN SYSTEMS INTEGRATION/SEAPRINT							
	972	1,485	0	0	0	0	0	0
R9324	NAVAL MAINTENANCE MANAGEMENT							
	964	0	0	0	0	0	0	0
R9325	ON-LINE ELECTRO-HYDRODYNAMIC FILTER							
	2,887	0	0	0	0	0	0	0
R9326	PHOTONIC MACHINING APPLICATIONS							
	961	0	0	0	0	0	0	0
R9327	REDUCTION OF CATAPULT POST-RETRACTION EXHAUST DISCHARGE							
	961	0	0	0	0	0	0	0
R9328	TITANIUM MATRIX COMPOSITES PROGRAM							
	1,734	0	0	0	0	0	0	0
R9473	ASPHALT RECONDITIONER							
	0	1,684	0	0	0	0	0	0
R9474	HEET							
	0	4,953	0	0	0	0	0	0
R9475	INTELLIGENCE WORK MANAGEMENT							
	0	1,684	0	0	0	0	0	0
R9476	MINE WARFARE TECHNOLOGY SOLUTIONS (MWTS)							
	0	2,576	0	0	0	0	0	0
R9477	NADEP CHERRY POINT CENTER FOR VERTICAL LIFT AIRCRAFT REPAIR AND MAINTENANCE TECHNOLOGY PROGRAM							
	0	1,981	0	0	0	0	0	0
R9479	ULTRASONIC CONSOLIDATION OF MATRIX COMPOSITES							
	0	991	0	0	0	0	0	0

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PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

R9480	VIRTUAL AT SEA TRAINING INITIATIVE						
	0	991	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Warfighter Sustainment Advanced Technology supports: Manpower and Personnel, Training, and Readiness; and the Future Joint Warfighting Capabilities identified by the Joint Chiefs of Staff. It supports the Future Naval Capabilities (FNC) Program in Airframe/Ship Corrosion; Turbine Engine Technologies; Littoral Combat; Sea Base Planning, Operations and Logistics; and Sea Base Mobility and Interfaces. It develops technologies that enable the Navy to better 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 enable reduced operating costs through life-extension of legacy systems and increased efficiency of future propulsion systems and improved diagnostic tools. The Expeditionary Logistics investment addresses transformational Naval surface distribution/replenishment techniques, and improves the situational awareness of readiness and operating logistics status.

Within the Naval Transformation Roadmap, this investment supports the achievement of all the transformational capabilities of Sea Warrior and the transformational capabilities of: Ship to Objective Maneuver and Time Sensitive Strike required by Sea Strike; Littoral Sea Control and Anti-Sub Warfare required by Sea Shield; Compressed Deployment and Employment Times and Enhanced Sea-Borne Positioning of Assets required by Sea Basing; and Battlespace Integration required by FORCEnet.

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

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N
PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	86,464	61,103	62,693	65,333
Cong Rescissions/Adjustments/Undist. Reductions	0	-2,374	0	0
Congressional Action	0	33,000	0	0
Execution Adjustments	3,100	0	0	0
FNC Realignment	0	0	4,093	4,548
General S&T Reduction	0	0	-7,200	0
Non-Pay Inflation Adjustments	-80	0	2	3
Program Adjustments	0	-64	-121	-123
Program Realignment	0	0	9,066	12,715
Rate Adjustments	0	0	7	147
SBIR Assessment	-2,203	0	0	0
FY 2006/2007 President's Budget Submission	87,281	91,665	68,540	82,623

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: R2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R2915 WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	54,250	58,974	68,540	82,623	85,106	83,288	74,450	116,141

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Warfighter Sustainment Advanced Technology supports Manpower and Personnel, Training, and Readiness; and the Future Joint Warfighting Capabilities identified by the Joint Chiefs of Staff. It supports the Future Naval Capabilities (FNC) Program in Airframe/Ship Corrosion; Turbine Engine Technologies; Littoral Combat; Sea Base Planning, Operations and Logistics; and Sea Base Mobility and Interfaces. It develops technologies that enable the Navy to better 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 enable reduced operating costs through life-extension of legacy systems, increased efficiency of future propulsion systems and improved diagnostic tools. The Expeditionary Logistics investment addresses transformational Naval surface distribution/replenishment techniques, and improves the situational awareness of readiness and operating logistics status.

Within the Naval Transformation Roadmap, this investment supports the achievement of all the transformational capabilities of Sea Warrior and the transformational capabilities of Ship to Objective Maneuver and Time Sensitive Strike required by Sea Strike; Littoral Sea Control and Anti-Submarine Warfare required by Sea Shield; Compressed Deployment and Employment Times and Enhanced Sea-Borne Positioning of Assets required by Sea Basing; and Battlespace Integration required by FORCEnet.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
SEA BASE PLANNING, OPERATIONS AND LOGISTICS	9,917	12,031	10,379	6,643

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: R2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

To more accurately group underlying efforts, this activity now includes investments formerly reported under Logistics Command and Control (C2) and Strike Up/Strike Down Selective Offload Systems. This activity includes support to the Future Naval Capabilities (FNC) Enabling Capabilities for Sea Base Collaborative Command and Control; Sea Base Integrated Operations; and Sea Base Mobility and Interfaces. Sea Basing will require more robust afloat command and control for sustainment activities. Logistics must integrate with the joint task force common operating picture, and provide awareness of mission supportability and readiness at an operational and tactical level. This activity will produce techniques and systems to support automated transfer of cargo from shipboard unload/onload point to stowage spaces. Technologies include high-strength composites, ship-motion compensation for force control-based systems, intelligent systems, and robotics.
FY 2004 - FY 2005 increase results from planned initiation of new project.
FY 2005 - FY 2007 decreases result from planned project transitions, especially the automated warehousing.

FY 2004 Accomplishments:

- Continued focus on maturing technology for automated storage and retrieval for Sea Base integrated operations.
- Continued prototype development of a compact agile material mover and an automated warehouse capability for Sea Base platform.
- Completed a prototype logistics C2 software module for ashore units and deployed it to Operation Iraqi Freedom/Operation Enduring Freedom.
- Initiated planning for software development for the afloat component of Naval sustainment C2.

FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed above.
- Initiate new prototype to handle container movement aboard ship.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: R2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Complete automated warehousing for the Sea Base including a demonstration of integrated operations.

	FY 2004	FY 2005	FY 2006	FY 2007
SEA BASE MOBILITY AND INTERFACES	7,371	8,498	11,881	22,621

To more accurately group underlying efforts, this activity now includes investments formerly reported under At Sea Arrival and Assembly, and Sea Base to Shore Surface Craft. This activity includes support to the Future Naval Capabilities (FNC) Enabling Capabilities for Sea Base Integrated Operations, and Sea Base Mobility and Interfaces. This activity improves the capability for transfer of personnel and cargo between Sea Base/logistics vessels and unimproved beaches during high sea states. Capabilities being developed include propulsion technologies, cargo stabilization technologies, advanced hull form technologies and fabrication of lightweight robust structures needed for sustained operations at high speed in a moderate seaway. This activity further supports the Sea Basing mission of marrying troops to equipment, and providing support to seaborne forces via surface distribution interfaces. It will improve current underway replenishment capabilities for transfer of cargo between Sea Base/logistics vessels (large ship-to-ship) during high sea states, while increasing ship separation for safety.
FY 2004 - FY 2007 increases result from the planned initiation of new projects to support the Navy's developing seabasing concept of operations.

FY 2004 Accomplishments:

- Continued design studies and conducted limited prototyping and model basin testing.
- Continued investment and technology development in ship to ship securing systems and seaway cargo handling technologies.
- Continued development of high capacity at sea transfer capabilities between large afloat vessels from industry, coalition, and Naval forces.
- Completed heavy lift surface transport development and the study of beachable heavy lift surface transport.
- Completed work in heavy lift landing craft air cushion technologies.
- Initiated work in station keeping for two platforms at sea.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
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FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed above.
- Complete design studies and conduct limited prototyping and model basin testing.
- Complete work in station keeping and scale demonstrations in a relevant environment.
- Initiate technology exploration in hydrodynamic impacts and design space trade studies.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Initiate work for a beachable high speed craft as a Sea Base mobility interface.
- Initiate work in small to large at-sea vessel interfaces.
- Initiate work in high rate horizontal and vertical material movement within the Sea Base.

FY 2007 Plans:

- Continue all efforts of FY 2006 less those noted as completed above.
- Initiate work for technology support of the 53X heavy lift vertical air platform Sea Base mobility interface.

	FY 2004	FY 2005	FY 2006	FY 2007
FRICTION DRAG REDUCTION	0	0	0	2,502

This program is a collaborative effort with the Defense Advanced Research Agency (DARPA) and the Program Executive Officer for Ships (PEO Ships). The objective is to unambiguously demonstrate the performance of large-scale predictive models that incorporate sufficient physics from first-principles models on a large or full-scale ship test vehicle.
FY 2006 - 2007 increase due to program start up.

FY 2007 Plans:

- Initiate design of an optimal implementation of additive-based drag reduction technology using large-

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: R2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

scale predictive models.

	FY 2004	FY 2005	FY 2006	FY 2007
SEA BASING	0	0	5,343	9,339

This activity includes advancement of technologies to support the design and development of Sea Basing Innovative Naval Prototypes. Areas include design and development of various Sea Basing prototypes in the areas of high speed, shallow draft and beachable connectors; vessel to vessel interfaces; and automated and integrated warehousing.
2005 - 2006 increase due to program start up.
2006 - 2007 increase due to initiation of further efforts.

FY 2006 Plans:

• Initiate prototype designs in the areas of high speed, shallow draft and beachable connectors; vessel to vessel interfaces; and automated and integrated warehousing.
• Initiate advanced technology development of selected Sea Basing technologies which would support prototype design. Technologies include: lift cushion seal challenges such as lightweight, high strength, long wear materials; variable geometry/retractability; sea state four capability as well as lighter weight, more efficient lift fans; automatic connector/mating systems; innovative seal systems; vertical/horizontal transition of conveyance and autonomous; and low power consumption intraship transport systems.

FY 2007 Plans:

• Continue all efforts of FY 2006 less those noted as completed above.
• Initiate model demonstration and testing.
• Initiate detailed design of Sea Basing prototypes utilizing selected technologies from FY06 development.

	FY 2004	FY 2005	FY 2006	FY 2007
MANPOWER AND PERSONNEL DEVELOPMENT	4,714	3,123	7,093	6,985

This activity provides Navy personnel system managers with the ability to attract and retain the right people and to place them in jobs that best use their skills, training, and experience. Application of modeling and

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: R2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

simulation, mathematical optimization, advanced testing, statistical forecasting, information visualization, data warehousing, data cleansing, web-based knowledge management, and human performance measurement technologies enhances Fleet readiness and reduces personnel costs.
2004 - 2005 decrease due to rebalancing of funds.
2005 - 2006 increase due to planned initiation of integration projects.

FY 2004 Accomplishments:

- Continued Attrition Reduction Technologies, which demonstrate the use of attrition, cultural, and organizational measures between applicants/Sailors and the Navy that can be mitigated.
- Continued Non-Cognitive Measures of Personality and Social Competency related to teamwork, Navy adaptability, leadership, and job performance to be applied in personnel selection and classification.
- Continued Career Case Manager Technologies, which integrates intelligent agents, simulation models, and statistical methods to support Sailor/Marine career planning and decision making.
- Continued Distribution Incentive System, which incorporates the economic methods, business rules, and incentive structures to incentivize traditionally difficult-to-fill assignments or locations.
- Continued Web Based Marketplace for Sailors and Jobs, the computational operating environment in which the command, broker, and Sailor cognitive agents will interface to distribute and assign military personnel.
- Continued Enterprise Management System, which provides near-term decision support for personnel policy and resource allocation and long-range personnel enterprise strategic planning “executive simulation”.
- Completed the Enlisted Manpower and Personnel Integrated Planning System (EMPIPS), an integration of compensation models into a decision support system and database for enlisted manpower and personnel planning.

FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed above.
- Complete Attrition Reduction Technologies.
- Complete Enterprise Management System.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
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- Complete Non-Cognitive Measures.
- Complete Career Case Manager Technologies.
- Complete Distribution Incentive System.
- Initiate Cultures and Values Selection to measure the practical and predictive validity of socialization measures for selection into the military and assess their potential for classification use.
- Initiate Integrated Whole Person Assessment, which integrates Attrition Reduction Technologies, Non-Cognitive Measures, and Rating Identification Engine (RIDE)/Job and Occupational Interest in the Navy (JOIN).
- Initiate Integrated Sailor/Marine Career Management System, which integrates Career Case Manager Technologies, Distribution Incentive System, and Web-Based Marketplace.
- Initiate Integrated Personnel Situational Monitoring, Analysis, and Response Technologies, which integrates Enlisted Manpower and Personnel Integrated Planning System and Enterprise Management System.

FY 2007 Plans:

- Complete Cultures and Values Selection.
- Complete Integrated Whole Person Assessment.
- Complete Web Based Marketplace.
- Complete Integrated Sailor/Marine Career Management System.
- Complete Integrated Personnel Situational Monitoring, Analysis, and Response Technologies.

	FY 2004	FY 2005	FY 2006	FY 2007
TRAINING SYSTEMS	11,139	13,846	12,694	12,022

This activity improves mission effectiveness and safety by applying both simulation and instructional technology to the design of affordable education and training methods and systems. Improved training efficiency and cost-effectiveness is achieved by applying operations research, modeling and simulation, and instructional, cognitive, and computer sciences to the logistics, development, delivery, evaluation, and execution of training.
2004 - 2005 increase due to rebalancing of funds and the initiation of planned projects.
2005 - 2006 decrease due to planned completion of projects.

FY 2004 Accomplishments:

- Continued debriefing technologies.

BUDGET ACTIVITY: 03
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- Continued Battle Group Level Advanced Under Sea Warfare (USW) visualization systems and developed prototype system integrated with Composable FORCEnet.
- Continued focus on Virtual Technologies and Environments (VIRTE) Demonstration II, and performance assessment tools.
- Completed distributed learning guidelines for development of Navy courseware.
- Completed integration of existing technologies to produce an advanced fire support prototype for Virtual At Sea Training (VAST).
- Initiated advanced technologies for Interactive Electronic Technical Manuals.
- Initiated task to evaluate alternative ways to display information in the cockpit to support Naval air combat training in airborne platforms, exploiting the training capabilities offered by VAST.

FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed above.
- Complete development of human performance assessment tools for Navy-wide distributed learning.
- Complete Battle Group Level Advanced Under Sea Warfare (USW) visualization systems.
- Complete alternate cockpit information display evaluations.
- Initiated Virtual Technologies and Environments (VIRTE) Demo III, which provides integrated virtual training across the full spectrum of combat.
- Initiate advanced technologies for collaborative network-centric visualization systems.
- Initiate and complete architecture design for integrating Naval surface fire support and air VAST technologies into a joint operations constellation that includes cross-echelon and multi-platform training.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete debriefing technologies.
- Complete VIRTE Demonstration II.

FY 2007 Plans:

- Complete VIRTE Demonstration III.
- Complete advanced technologies for Interactive Electronic Technical Manuals.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
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- Complete advanced technologies for collaborative network-centric visualization systems.

	FY 2004	FY 2005	FY 2006	FY 2007
HUMAN SYSTEMS INTEGRATION	1,352	1,249	0	0

This effort supports the warfighter by designing affordable user-centered systems that are easy to use and train. Focus is on the application of a reusable user-centered design process to design a user interface to support user tasks, extract software requirements, and develop software design models.
2005 - 2006 decrease due to program termination.

FY 2004 Accomplishments:

- Continued focus on integration of Human-Computer Interaction (HCI) designs, and software architecture designs for Land Attack systems, specifically the Tactical Tomahawk Weapon Control System (TTWCS) builds.

FY 2005 Plans:

- Complete integration of Land Attack task and HCI designs into TTWCS builds.
- Complete software architecture design to accommodate task-based user interface for Land Attack systems.

	FY 2004	FY 2005	FY 2006	FY 2007
TURBINE ENGINE TECHNOLOGY - INTEGRATED HIGH PERFORMANCE TURBINE ENGINE TECHNOLOGY (IHPTET)/ VERSATILE AFFORDABLE ADVANCED TURBINE ENGINES (VAATE)	9,322	10,646	11,101	11,122

This activity provides integration and experimental engine testing of new gas turbine engine technologies to demonstrate readiness and reduce technical risk for entering engineering development. IHPTET is a tri-service program in which each service contributes established shares of advanced technology funding and laboratory resources to meet specified goals. This activity covers the Navy's share. The objective of VAATE is to develop and demonstrate versatile, durable, “intelligent” engine technologies for the spectrum of legacy, pipeline, 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.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
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FY 2004 - FY 2005 increases due to fund planned completions and initiation of follow on projects.

FY 2004 Accomplishments:

• Continued focus on the Phase II & III Joint Technology Demonstrator Engine (JTDE), General Electric (GE)/Allison Advanced Development Company (AADC) and Pratt & Whitney (P&W) demonstrator engines, and Phase III Joint Turbine Advanced Gas Generator (JTAGG) development, and core test Honeywell Engine and Systems (HES) demonstrator.
• Initiated VAATE Phase I: Component design and technology development to meet the VAATE Phase I goals.

FY 2005 Plans:

• Continue all efforts of FY 2004 less those noted as completed above.
• Complete the Phase II JTDE (GE/AADC) demonstrator engine.
• Complete the Phase III JTDE (GE/AADC P&W) demonstrator engines.
• Initiate VAATE Phase I: Design, component development, integration and fabrication of Phase I demonstrator engines.

FY 2006 Plans:

• Continue all efforts of FY 2005 less those noted as completed above.
• Complete the Phase III JTAGG development and final core test of HES demonstrator.

FY 2007 Plans:

• Continue all efforts of FY 2006 less those noted as completed above.
• Initiate testing of VAATE Phase I demonstrator engines with GE and P&W.

	FY 2004	FY 2005	FY 2006	FY 2007
AIRFRAME/SHIP CORROSION	4,967	4,836	3,974	7,984

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

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
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management technologies. This is particularly significant to life extension for the aging fleet.
FY 2005 - FY 2006 decrease is due to rebalancing of FNC funding.
FY 2006 - FY 2007 increase is to fund planned completions.

FY 2004 Accomplishments:

- Continued Airframe Corrosion effort, development of road test method for Marine Corps vehicles and single coat system for ship tanks (potable water and fuel tanks).
- Completed the development of single coat systems for ship tanks (ballast tank) and demonstrated on 32 ballast tanks, 2 potable water tanks and 4 voids on carrier.
- Completed development of Corrosion and Corrosivity Monitoring System (C2MS) for aircraft.
- Completed construction of Modular Hybrid Pier (MHP) modules for test bed and design of mooring system.
- Initiated the development of Nondestructive Inspection (NDI) Technology for aircraft metal and composite structures to detect cracks and defects.

FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed above.
- Complete single coat system for ship tanks (potable water tank), Corrosion Preventive Compounds (CPCs), and NDI technology for corrosion detection for aircraft structures.
- Initiate the development of single coat systems for Collection-Holding-Transfer (CHT) ship tanks.
- Initiate NDI technology for heat damage detection on composite materials.

FY 2006 Plans:

- Continue all efforts of FY 2005 less those noted as completed above.
- Complete single coat system for ship tanks (fuel tank).

FY 2007 Plans:

- Complete single coat system for ship tanks (CHT tank).
- Complete road test methodology.
- Complete development of NDI technology for aircraft metal and composite structures for cracks and

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
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defects.
• Complete NDI technology for heat damage detection on composite materials.

	FY 2004	FY 2005	FY 2006	FY 2007
SMART WIRING	542	0	0	0

Smart Wiring is a subset of the Total Ownership Cost (TOC) Future Naval Capability (FNC). Smart Wiring develops flight-qualified smart aircraft wiring system hardware and performs required flight demonstrations. Smart wiring reduces wiring maintenance man-hours, reduces wiring induced mission aborts and non-mission capable hours, and reduces in-flight electrical fires and subsequent loss of aircraft.

FY 2004 Accomplishments:

• Completed Smart wires flight development/test/certification.

	FY 2004	FY 2005	FY 2006	FY 2007
LITTORAL COMBAT	3,678	4,745	6,075	3,405

The goal of Littoral Combat is the application of technologies to enhance the ability of the Navy/Marine Corps team to execute the Naval portion of a joint campaign in the littorals. This activity considers all the critical functions of warfighting: command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR), fires, maneuver, sustainment, force protection, and training. This activity includes support to the Future Naval Capabilities (FNC) Enabling Capabilities for: Reduce Support Costs 1, Advanced Naval Fires Technology Spiral 1, Combatant Commander (COCOM) to Marine Combat Identification (ID), Global Information Grid (GIG)-Compliant Networking, Hostile Fire Detection and Response Spiral 2, Position-Location-Information, Reduce Cost of Operations 1, Sea Base Collaborative Command and Control, Sea Base Mobility and Interfaces, and Sea Base Integrated Operations.
FY 2004 - FY 2005 funding increase due to program growth.
FY 2005 - FY 2006 funding increase due to program maturation, testing, and demonstrations.
FY 2006 - FY 2007 funding decrease due to program transitions.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: R2915 PROJECT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

FY 2004 Accomplishments:

- Continued Position Location Information (PLI) Phase 1, including capability to develop algorithms for indirect fires effects.
- Continued development of innovative relays (Beyond Line of Sight (BLOS))in the areas of wideband communications between command posts and narrowband communications between maneuver elements and their headquarters.
- Continued integration and demonstration of secure mobile network/secure wireless Local Area Network (LAN) technologies, including advanced protocols, frequency conversion and power amplification.
- Completed industry survey and initiated service coordination effort for Organic Light Emitting Diode (OLED) display technologies.
- Initiated development of a capability to rapidly generate a terrain database for use in simulations for evaluation of maneuver plans.
- Initiated efforts on network management tools to increase the reliability and availability of tactical networks by improving network performance and security. (FY05 effort funded by PE 0602131M).

FY 2005 Plans:

- Continue development of Phase 1 of the Position Location Information (PLI) system technology development.
- Continue development of innovative relays (BLOS) communications.
- Continue integration and demonstration of secure mobile network/wireless LAN technologies.
- Continue development effort for OLED display technologies.
- Continue development of a capability to rapidly generate a terrain database.
- Continue modeling and testing of the advanced weapon materials technology efforts on the Expeditionary Fires Support System (EFSS) artillery and mortar systems.
- Continue development of advanced target acquisition (target hand off and target location) technologies for both mounted and dismounted applications. (Previous efforts funded by PE 0603782N)
- Continue development and integration of improved fire control systems for direct and indirect fire weapons. (Previous efforts funded by PE 0603640M)
- Initiate development of technology to enhance navigation in a Global Positioning System (GPS) denied environment.
- Initiate development of integrated vehicle self-defense system to defeat incoming Rocket Propelled Grenades (RPGs).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
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FY 2006 Plans:

- Continue development of innovative relays (BLOS) communications. (FY07 effort to be funded by PE 0603640M)
- Continue integration and demonstrations of secure mobile network/secure wireless LAN technologies.
- Continue testing of the advanced weapon materials technology efforts on EFSS artillery and mortar systems.
- Continue development of advanced target acquisition technologies (target hand off and target location).
- Continue development of integrated vehicle self-defense system to defeat incoming RPGs.
- Continue development of technology to enhance navigation in a GPS denied environment.
- Continue development and integration of improved fire control systems for direct and indirect fire weapons. (FY07 effort funded by PE 0603782N)
- Continue development of lightweight computational fire control interface technology. (Previous effort funded by PE 0603782N; FY07 effort to be funded by PE 0603782N)
- Complete Phase 1 of the PLI system technology development and initiate Phase 2.
- Complete development effort for OLED display technologies.
- Complete development of and transition a capability to rapidly generate a terrain database.

FY 2007 Plans:

- Continue development of integrated vehicle self-defense system to defeat incoming RPGs.
- Continue development of technology to enhance navigation in a GPS denied environment.
- Complete integration and demonstration of secure mobile network/wireless LAN technologies.
- Complete testing of the advanced weapon materials technology efforts on the EFSS artillery and mortar systems.
- Complete development and transition of advanced Naval fires target acquisition technologies

	FY 2004	FY 2005	FY 2006	FY 2007
CONSUMPTION REDUCTION	1,248	0	0	0

This effort provided technologies and processes for managing shipboard logistics across the spectrum of the Sea Based forces, to Navy and Marine Corps logistics needs. Energy production and storage and advanced

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
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materials formed the technology foundation.

FY 2004 Accomplishments:

- Completed blast mitigation advanced materials packaging modeling, development, testing, and evaluation.

C. OTHER PROGRAM FUNDING SUMMARY:
RELATED RDT&E:

NAVY RELATED RDT&E:
PE 0206624M - Marine Corps Combat Services Support
PE 0601103N - University Research Initiatives
PE 0601152N - In-House Laboratory Independent Research
PE 0601153N - Defense Research Sciences
PE 0602123N - Force Protection Applied Research
PE 0602236N - Warfighter Sustainment Applied Research
PE 0603512N - Carrier Systems Development
PE 0604703N - Personnel, Training, Simulation, and Human Factors
PE 0605013M – Information Technology Development
PE 0605152N - Studies and Analysis Support, Navy

NON NAVY RELATED RDT&E:
PE 0601102A - Defense Research Sciences
PE 0602211A - Aviation Technology
PE 0603003A - Aviation Advanced Technology
PE 0603007A - Manpower, Personnel and Training Advanced Technology
PE 0601102F - Defense Research Sciences
PE 0602203F - Aerospace Propulsion
PE 0603216F - Aerospace Propulsion and Power Technology

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: R9150 PROJECT TITLE: INTEGRATED VEHICLE HEALTH MANAGEMENT SYSTEM

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R9150 INTEGRATED VEHICLE HEALTH MANAGEMENT SYSTEM	4,025	2,576	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Interactive Multisensor Analysis Training (IMAT) project is aimed at improving the preparation of operational users of undersea-warfare sensor systems. IMAT provides exploratory environments in which operators and tacticians examine the effects of change in any of the variables involved in the end-to-end sequence of emission, transmission, reflection, and detection. Sensor settings, environmental conditions and target characteristics can all be modified through a "what-if" simulation approach. The effort focuses on training technology at the battlegroup, fleet, and theater levels.

Note: Integrated Vehicle Health Management System (FY04 $2,460; FY 2005 $2,576) and On-Line Electro-Hydrodynamic Filter ($2,887) are discussed in the Congressional Plus-Ups section.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
INTERACTIVE MULTISENSOR ANALYSIS TRAINING (IMAT)	1,565	0	0	0

The Interactive Multisensor Analysis Training (IMAT) project developed improved training technologies for anti-submarine warfare (ASW) in support of Sea Warrior, Sea Shield, and Pacific Fleet requirements.

FY 2004 Accomplishments:

- Completed the development and application of IMAT techniques for visualization-based training.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: R9150 PROJECT TITLE: INTEGRATED VEHICLE HEALTH MANAGEMENT SYSTEM

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 0602236N - Warfighter Sustainment Applied Research
PE 0604703N - Personnel, Training, Simulation, and Human Factors
PE 0605152N - Studies and Analysis Support, Navy

NON NAVY RELATED RDT&E:
PE 0601102A - Defense Research Sciences
PE 0603007A - Manpower, Personnel and Training Advanced Technology
PE 0601102F - Defense Research Sciences

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

R9014	FY 2004	FY 2005
PRECISION FABRICATION OF LARGE CURVED STEEL NAVY SHIP STRUCTURES	0	1,981

FY05: This effort will use precision fabrication of large curved steel beams in the application of new concepts of hybrid stainless steel/composite construction to Navy ship structures. Hybrid ship construction will provide low magnetic signatures, increased survivability, low maintenance, and light weight for high speed ships for Littoral Combatant Ship applications. Application of precision fabrication using computer controlled welding and metrology to control weld distortions are key to low cost manufacturing.

R9021	FY 2004	FY 2005
LOW VOLUME PRODUCTIVITY	0	1,485

FY05: This effort will establish a laser repair facility which is fully robotic and which uses a higher power laser than was previously available. Such a facility enables the economical repair of shipboard components which are likely to reach a navy repair facility in very small numbers (frequently "one of a kind").

R9023	FY 2004	FY 2005
INTERMEDIATE MODULUS COTS CARBON FIBER QUALIFICATION	1,921	0

FY04: This effort developed a high volume manufacturing technique for production of intermediate modulus (IM) carbon fibers that will be incorporated into strong lightweight polymer composites. This material enabled the development of advanced, lightweight, long-range Navy aircraft such as the Joint Strike Fighter.

R9147	FY 2004	FY 2005
DEFENSE SYSTEMS MODERNIZATION AND SUSTAINMENT INITIATIVE	1,932	3,963

FY04: This effort conducted systems modernization, readiness assessment and tracking in four specific focus areas: Material Aging; Life Cycle Engineering and Economic Decision Systems; Asset Health Management; and

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

Reliability, Availability and Maintainability Initiatives.

FY05: The Asset Health Management area will be expanded from the single vehicle to the fleet level through co-funding with the Marine Corps Warfighting Laboratory. Integration of the system into Intelligent Maintenance will begin. Prognostic sensing and assessment technologies will be expanded to electronic components. The effort will develop the required reverse engineering/restoration technology for critical legacy components for ground and air vehicles.

R9148	FY 2004	FY 2005
EMERGING/CRITICAL INTERCONNECTION TECHNOLOGY	3,363	0

FY04: This effort facilitated solutions to current military problem areas and evaluated leading edge design and manufacturing technologies for both future military and commercial requirements prior to adoption by printed circuit board manufacturers.

R9150	FY 2004	FY 2005
INTEGRATED VEHICLE HEALTH MANAGEMENT SYSTEM	2,460	2,576

Note: This effort was previously titled "Integrated Aircraft Health Management".

FY04 - This effort initiated the development of data interoperability software tools, diagnostic algorithms, and processes to ensure improved affordability and safety through the application of integrated aircraft health management practices.

FY05 - This effort will demonstrate data interoperability software tools and diagnostic algorithms on F/A-18 E/F flight control actuators and propulsion system, as well as select C-17, V-22 and/or commercial platform systems. The technology will enable reduced operating costs through life-extension of legacy systems and will enable improved diagnostic tools that will decrease the number of unnecessary parts removals.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9151	FY 2004	FY 2005
CAFFING PROTECTION SYSTEM	0	1,388

FY05: This effort will develop and transition a condition based monitoring technology for onboard detection, diagnostics, and prognostics of wire chaffing onboard Navy aircraft. The main tasks will be to flight test a current prototype onboard an H-53 helicopter, and to enhance a previously developed prototype by increasing its sensitivity and reducing the interrogation time. 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.

R9318	FY 2004	FY 2005
AUTOGEN	2,887	0

FY04: This effort supported the commercialization phase to parallelize multi-processor driven applications for next generation shipbuilding.

R9319	FY 2004	FY 2005
AUTOMATIC CONTAINER AND CARGO HANDLING SYSTEMS	1,937	1,981

FY04: This effort produced a scaled demonstration of a multi-point control system and mast system for cargo transfer of containers at sea, in up to sea state 5.

FY05: This effort will design, fabricate, and test a full scale active AutoLog spreader bar system for lifting containers and cargo while at sea.

R9320	FY 2004	FY 2005
EXPEDITIONARY LOGISTICS FOR THE 21ST CENTURY (EXLOG21)	964	2,972

FY04: This effort completed work on a software prognostic vehicle health monitoring system, focused on the engine and drive train, to accurately forecast readiness posture. This effort also initiated the Material Control Officer (MATCONOFF) software development project Space and Warfare Systems office PMW 151.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

FY05: This effort will complete the MATCONOFF software development and transition the product to PMW 151.

R9321	FY 2004	FY 2005
EXTREME ENVIRONMENT URBAN WARFARE RESEARCH	959	0

FY04: This effort conducted research to determine the possibilities of modeling the effects of one or many extreme environmental conditions (heat, cold, wind, darkness, altitude, high or low humidity, etc.) on human physiology, psychology, and performance.

R9321	FY 2004	FY 2005
FLIGHT/HANGER DECK CLEANER IMPROVEMENTS	2,452	0

FY04: This effort developed a full scale prototype of a deck scrubber for Naval platform flight decks, suited for removing oils and exhaust without damage to the non-skid deck plate and with low environmental disposal impact.

R9323	FY 2004	FY 2005
HUMAN SYSTEMS INTEGRATION/SEAPRINT	972	1,485

Note: This effort was previously titled "IMPRINT".

FY04: This effort completed and tested Human Systems Integration (HSI) specifications adopted from Army MANPRINT technology. It tested HSI tenets for performance improvements on a Navy platform.

FY05: This effort will include additional test platforms to ascertain performance outcomes: controlling for cognitive and non-cognitive factors for each test subject group. Also there will be an inclusion of meta-heuristic optimization algorithms to ascertain optimal performance outcomes subject to varying HSI tenets and test platforms.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9324	FY 2004	FY 2005
NAVAL MAINTENANCE MANAGEMENT	964	0

FY04: This effort focused on streamlining required maintenance and predicting failures so prevention maintenance can be performed.

R9325	FY 2004	FY 2005
ON-LINE ELECTRO-HYDRODYNAMIC FILTER	2,887	0

FY04: This effort performed innovative research and product development in two areas: oil quality sensing using broadband electrochemical impedance and oil filtering system based on dielectrophoresis filtering technology.

R9326	FY 2004	FY 2005
PHOTONIC MACHINING APPLICATIONS	961	0

FY04: This effort supported machining small features for micro-electronics using the Femto Second Laser.

R9327	FY 2004	FY 2005
REDUCTION OF CATAPULT POST-RETRACTION EXHAUST DISCHARGE	961	0

FY04: This effort supported development of a dry lubricant for aircraft carrier catapult hardware and combined this technology with the capability to wirelessly monitor the health of the components lubricated.

R9328	FY 2004	FY 2005
TITANIUM MATRIX COMPOSITES PROGRAM	1,734	0

FY04: This effort developed a lightweight produciable composite metal for key components of the joint strike fighter, to include candidates of the engine and hook components.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9473	FY 2004	FY 2005
ASPHALT RECONDITIONER	0	1,684

FY05: This effort will facilitate the application of GSB-88, which is a complex asphalt emulsion product specifically engineered to retard surface oxidation of asphalt pavement; monitor the performance of GSB-88 to prevent premature oxidation and corrosion of the asphalt infrastructure;
and assess cost savings in asphalt preservation cost.

R9474	FY 2004	FY 2005
HEET	4,112	4,953

Note: This effort was previously titled "Energy and Environmental Technology".

FY04: This effort tested and developed advanced fuel cell systems for military and civilian application, and explored and characterized sea-floor methane hydrates as a potential fuel source. In FY04 it completed the Third International Workshop of Methane Hydrate Research and Development in Vina del Mar Chile and participated in an international research expedition on the Cascadia Margin off the Coast of British Columbia, Canada. The effort also established official collaboration with the Naval Underwater Warfare Center (NUWC) Hawaii. Accomplishments under the methane hydrates activity included the exploration and characterization of new methane hydrate beds, implementation of international partnerships and workshops, and development of a state-of-the-art laboratory to characterize hydrate properties.

FY05: This effort will continue its partnership with the Naval Research Laboratory to test and develop advanced fuel cell systems for military and civilian application, and to explore and characterize sea-floor methane hydrates as a potential fuel source. The fuel cell activity will focus on the development of strong industrial partnerships providing access to state-of-the-art-fuel cells, and the use of the laboratory facility to characterize the performance and durability of cells and cell components for Navy applications.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9475	FY 2004	FY 2005
INTELLIGENCE WORK MANAGEMENT	0	1,684

FY05: This effort will develop network technologies to significantly increase the speed and efficiency by which shipboard maintenance problems are identified, replacement parts are located, and maintenance personnel are assigned to address the problems.

R9476	FY 2004	FY 2005
MINE WARFARE TECHNOLOGY SOLUTIONS (MWTS)	0	2,576

FY05: This effort will support the development of metrics; analysis tools; and the assessment engineering concepts, processes, systems, and technologies for mine countermeasures missions. This effort will emphasize the use of unmanned surface vehicles for mine countermeasures missions.

R9477	FY 2004	FY 2005
NADEP CHERRY POINT CENTER FOR VERTICAL LIFT AIRCRAFT REPAIR AND MAINTENANCE TECHNOLOGY PROGRAM	0	1,981

FY05: This effort will provide for science and technology insertion into a dedicated activity to identify, demonstrate, validate, and assist in implementing improved maintenance products, procedures, and processes into depot operations. The payoff of these technology advancements will be increased readiness by improving maintenance operations and decreasing maintenance cycle times for rotary wing aircraft.

R9479	FY 2004	FY 2005
ULTRASONIC CONSOLIDATION OF MATRIX COMPOSITES	0	991

FY05: This effort will research new composite materials to be used in advanced munitions.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603236N PROGRAM ELEMENT TITLE: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9480	FY 2004	FY 2005
VIRTUAL AT SEA TRAINING INITIATIVE	0	991

FY05: This effort will extend the Virtual At Sea Training (VAST) system to new warfighting arenas including battlegroup level ASW training and mission rehearsal, and Marine Corps indirect fire weapons training for the full artillery team.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N
PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	60,933	71,743	75,070	50,041	29,609	30,590	51,332	52,607
R2913	RF SYSTEMS ADVANCED TECHNOLOGY							
	44,282	43,609	75,070	50,041	29,609	30,590	51,332	52,607
R9152	COMMON AFFORDABLE RADAR PROCESSOR							
	5,783	7,627	0	0	0	0	0	0
R9329	APY-6 REALTIME PRECISION TARGETING RADAR							
	4,805	2,477	0	0	0	0	0	0
R9330	HIGHLY MOBILE TACTICAL COMMUNICATIONS (HMTC)							
	1,636	2,972	0	0	0	0	0	0
R9331	REMOTE OCEAN SURVEILLANCE SYSTEM (ROSS)							
	2,017	1,485	0	0	0	0	0	0
R9332	SCOUT (LPI) RADAR DEMONSTRATION							
	2,410	0	0	0	0	0	0	0
R9481	C BAND ACTIVE ARRAY RADAR							
	0	6,340	0	0	0	0	0	0
R9482	HORIZON EXTENSION SURVEILLANCE SYSTEM (HESS)							
	0	2,081	0	0	0	0	0	0
R9483	MINIATURE AUTOMATIC FUSION SPLICER							
	0	991	0	0	0	0	0	0
R9484	PHOTONICS PROTOTYPING FACILITY							
	0	4,161	0	0	0	0	0	0

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N
PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Work in this Program Element (PE) addresses technologies critical to enabling the transformation of discrete functions 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, EW 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. 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.

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

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N
PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	62,041	44,046	53,105	53,226
Cong Rescissions/Adjustments/Undist. Reductions	0	-686	0	0
Congressional Action	0	28,400	0	0
Execution Adjustments	355	0	0	0
Federal Technology Transfer	-30	0	0	0
FNC Realignment	0	0	26,697	16,733
Non-Pay Inflation Adjustments	-58	0	0	0
Program Adjustments	0	-17	-70	-41
Program Realignment	0	0	-4,682	-20,023
Rate Adjustments	0	0	20	146
SBIR Assessment	-1,375	0	0	0
FY 2006/2007 President's Budget Submission	60,933	71,743	75,070	50,041

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: R2913 PROJECT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R2913 RF SYSTEMS ADVANCED TECHNOLOGY	44,282	43,609	75,070	50,041	29,609	30,590	51,332	52,607

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Radio Frequency (RF) Systems Advanced Technology project addresses technologies critical to enabling the transformation of discrete functions to network centric warfare which utilizes multiple, simultaneous and continuous communications/data links between platforms while simultaneously performing the functions of Electronic Warfare (EW) and radar surveillance. Work in this project addresses RF technology for Surface and Aerospace Surveillance sensors and systems, EW 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 (FNCs). 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.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
ADVANCED MULTI-FUNCTION RF TECHNOLOGY	18,458	22,364	33,977	23,048

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. Program goals include development and demonstration of multi functional RF technology applicable to systems development for DD(X) and other ship classes that will provide reduced recurring costs for total system functionality; reduced number of topside antennas and support systems; reduced ship radar cross section; reduced number of unique spares and lower ship manning requirements; provide ability to upgrade

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: R2913 PROJECT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

systems and capabilities with reduced cost, time, and complexity while mitigating the risk of obsolescence; and provide ability to rapidly exploit technological innovation through open systems concepts.

Major objectives within AMRF include multi function concept development, testing, and technology demonstration of communications, electronic attack, electronic surveillance, and radar functions within the AMRF-Concept (AMRF-C) Test Bed; development of a Multi Function Electronic Warfare/Electronic Surveillance (support) (MFEW/ES) Advanced Development Model (ADM) for DD(X) that demonstrates key Electronic Warfare Support (ES) capabilities for several simultaneous ES functions; development of an MFEW/ES ADM architecture that is capable of supporting additional RF functions; and conducting MFEW/ES ADM testing that satisfies DD(X) program Technology Development (TD) Phase requirements to enable a smooth transition of AMRF technology to the DD(X) System Development and Demonstration (SDD) Acquisition Phase with minimal changes in system architecture.

AMRF Systems Technology developments directly support the Department of Defense Joint Warfighter Science and Technology Plan and the Defense Technology Area Plans.
FY 2004 to FY 2005 and FY 2005 to FY 2006 increases due to FNC MFEW/ES; FY 2006 to FY 2007 decrease due to planned completion of efforts.

FY 2004 Accomplishments:

- Initiated development of a multi-function system ((MFEW)/Advanced Multi-function Radio Frequency Concept (AMRF-C) Version 2) capable of demonstrating integrated communications and Electronic Warfare (EW) for the AMRF-C effort.
- Completed multi function RF technology hardware, architecture, and component testing for the AMRF-C effort. Demonstrated the initial capability of the multi function RF technology testbed. This effort included initial designs for wideband technology with power and linearity sufficient to support communications, EW and limited radar functions.
- Continued and completed the operation of the wideband multi-function Communications and EW testbed in support of multi-function system development and multi-function technology insertion and demonstration for the AMRF-C effort.

FY 2005 Plans:

- Continue the MFEW/ES Program Technology Development Phase.
- Continue operation of the wideband multi-function Communications and EW testbed in support of multi-

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: R2913 PROJECT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

function system development and multi-function technology insertion and demonstration for the AMRF-C effort.
• Continue MFEW/ES Core Software Development.
• Initiate development of a High Band array antenna capable of simultaneously supporting multiple Electronic Support Measures (ESM)surveillance functions for the MFEW/ES ADM.
• Initiate development of a Mid Band array antenna capable of simultaneously supporting multiple ESM functions for the MFEW/ES ADM.
• Initiate development of back-end analog receiver equipment supporting MFEW/ES ADM.
• Initiate systems integration, risk reduction, and Navy critical subsystem development effort leading to demonstration of MFEW/ES ADM in a relevant environment and support MFEW/ES hardware/component testing within the AMRF-C testbed.

FY 2006 Plans:

• Continue all efforts of FY 2005.

FY 2007 Plans:

• Continue all efforts of FY 2006.
• Complete the MFEW/ES Program Technology Development Phase.
• Complete MFEW/ES Core Software Development.
• Complete development of a High Band array antenna capable of simultaneously supporting multiple ESM surveillance functions for the MFEW/ES ADM.
• Complete development of a Mid Band array antenna capable of simultaneously supporting multiple ESM functions for the MFEW/ES ADM.
• Complete development of back-end analog receiver equipment supporting MFEW/ES ADM.
• Complete systems integration, risk reduction, and Navy critical subsystem development effort leading to demonstration of MFEW/ES ADM in a relevant environment and support MFEW/ES hardware/component testing within the AMRF-C testbed.
• Initiate Shipboard EW Improvement and Electronic Attack (EA) Transmitter projects to develop Electronic Warfare/Electronic Attack capability for rapid technology insertion into DD(X) and other ship classes utilizing MFEW/ES ADM components and architecture and AMRF-C testbed technology.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: R2913 PROJECT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

	FY 2004	FY 2005	FY 2006	FY 2007
ELECTRONICS AND COMMUNICATIONS TECHNOLOGIES	25,824	21,245	41,093	26,993

This activity includes Future Naval Capabilities (FNC) investments formerly included in the Activity for Radio Communications Radio Frequency (RF) Advanced Technology and Surface and Aerospace Surveillance Advanced RF Systems. This additional breakout provides improved detail of the underlying investment.

The 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. The Radio Communications RF Technology includes support to the FNC Capabilities for: Advanced Communication for FORCEnet Knowledge Superiority and Assurance (KSA) Enabling Capability (EC) (KSA EC-4B); Global Information Grid (GIG) Compliant Networking (KSA EC-4C); Discrimination and Provision of Terminal Guidance for Weapons Targeted at Moving Targets (KSA(EC)-4B); Marine and UxV Tactical Intelligence Surveillance, and Reconnaissance (ISR) (KSA EC-7G); and Multi-Source ISR to the Warfighter (KSA EC-7B).

The 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. Surface and Aerospace Surveillance Advanced RF Systems includes support to the FNC for: Long Range RF Detection and Tracking Missile Defense (MD)(MD EC-1B); and Advanced Electronics Sensor Systems for MD (MD EC-1A). Also included are projects developed and demonstrated under the Fleet and Force Protection (F/FP) FNC. These include the Electronic Attack (EA) Techniques to Counter Advanced Threat and the Enhanced NULKA Payload projects. These Electronic Warfare projects support the Sea Shield Concept of the Naval Power 21 Strategic Plan. FY 2004 to FY 2005 decrease due to planned completion of efforts; FY 2005 to FY 2006 increase due to transfer of the High Altitude Relay from 0602235N and the new FNC initiative S-band Digital Array Radar; and FY 2006 to FY 2007 decrease due to planned completion of FNC efforts.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: R2913 PROJECT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

FY 2004 Accomplishments:

• Completed integration and performance evaluation of the S-Band receive phased array and transition into the AEGIS MD System.
• Completed design of full duplex phased array Ku-band antenna for Firescout Unmanned Airborne Vehicles (UAV) communication payload.
• Completed redesign for Q-band transmit phased array antenna.
• Completed K/Ka/Q-band fabrication of wideband mimic.
• Completed X-Ku band card assembly design transition to DDX Extremely High Frequency (EHF) Satellite Communication (SATCOM).
• Continued Integrated, Very High, Ultra High Frequency, L band (IVUL) multi-couplers for cosite mitigation.
• Completed fabrication and integration of the radar signal processor, receiver exciter and finalized the design for the 2-D array and rotary coupler for UAV installations
• Continued fabrication and platform integration; began testing of the Affordable Ground Based Radar (AGBR) project, an advanced development model (ADM) technology candidate for the Marine Corps Ground/Air Task-Oriented Radar (GATOR) (formerly Multi-Role Radar System (MRRS)) for use in defending mobile forces against air and missile attacks.

FY 2005 Plans:

• Initiate development of Ultra High Frequency (UHF)/L Band Phased Array Antennas for Carrier Vessel Nuclear (CVN).
• Initiate development of S-band Digital Array Radar.
• Initiate advanced development of Next Generation Communication at Speed and Depth (NGCSD).
• Initiate and complete a segment of the Missile Defense FNC Littoral Affordability effort (classified program).
• Initiate development of EA Techniques to Counter Advanced Threats.
• Initiate development of a Real Time Precision Surveillance Targeting (PS&T) Radar.
• Initiate demonstration and performance optimization of the integrated IVUL prototype antenna.
• Initiate Airborne Communications Package and complete airborne testing.
• Complete Real Time Composite Networking and transition to Advanced Digital Networking System (PMW-173).
• Complete development of X/Ku band phased array antenna.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
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• Complete ADM testing of the AGBR project in time to support Marine Corps Milestone B decision on the GATOR MRRS program in mid-FY 2005.

FY 2006 Plans:

• Continue all efforts of FY 2005 less those noted as completed above.
• Complete development of NGCSD advanced development demonstration unit.
• Complete demonstration and performance optimization of the integrated IVUL prototype antenna.
• Complete Airborne Communications Package and transition to Firescout UAV (PMA-263).
• Complete the integration of the PS&T radar system and conduct initial flight testing aboard the BAC-111 flight test Aircraft.
• Continue development of EA Techniques to Counter Advanced Threat by conducting field testing of Coherent EA Advanced Techniques Generator (ATG) and Digital Radio Frequency Memory (DRFM) Hardware.
• Initiate development of High Altitude Airborne Relay and Router Package.

FY 2007 Plans:

• Complete development of UHF/L Band Phased Array Antennas for CVN.
• Complete development of High Altitude Airborne Relay and Router Package.
• Complete development of S-band Digital Array Radar.
• Continue development of EA Techniques to Counter Advanced Threat by conducting field testing of the Coherent EA ATG and DRFM Hardware.
• Initiate Enhanced NULKA Payload project with the assembly and testing of a prototype transmit array using Gallium Arsenide (GaAs).

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)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: R2913 PROJECT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY

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 (ATD))

NON-NAVY RELATED RDT&E: Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

R9152	FY 2004	FY 2005
COMMON AFFORDABLE RADAR PROCESSOR	5,783	7,627

The FY 2004 effort developed a single Data Distribution Module (DDM) and demonstrated four input data streams and four output beams via open architecture Ethernet based interfaces.

The FY 2005 effort will be used to replicate and scale the baseline DDM and demonstrate row and column integration and scalability for the S-band radar digital beam forming application.

R9329	FY 2004	FY 2005
APY-6 REALTIME PRECISION TARGETING RADAR	4,805	2,477

The FY 2004 effort updated the current AN/APY-6 with a wideband surface mode, increased the number of test flight hours and additional software for surface target identification.

The FY 2005 effort will develop additional maritime modes and software for the APY-6 baseline. The Navy has a particular interest in "image while scan" and periscope detection modes. The plans include a high altitude data collection of sea clutter, to develop detection algorithms, and integrate "image while scan" processing.

R9330	FY 2004	FY 2005
HIGHLY MOBILE TACTICAL COMMUNICATIONS	1,636	2,972

The FY 2004 effort integrated Iridium satellite communications with current Expeditionary Maneuvering Warfare (EMW) Line-of-sight terrestrial tactical communication systems. Demonstrated Iridium tactical communication overlay technology.

The FY 2005 effort will design and develop the technology to provide a scalable networking demonstration for integrating military tactical radios (SINCGARS, EPLRS) with small form factor, ruggedized Iridium satellite handsets in order to provide over-the-horizon communications for Marine Corps warfighters. The focus will be

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

on the scalability of this networking technology in a realistic test environment with a large number of nodes in order to more accurately assess performance and future product suitability.

R9331	FY 2004	FY 2005
REMOTE OCEAN SURVEILLANCE SYSTEM (ROSS)	2,017	1,485

The FY 2004 effort was used to conduct experiments, develop algorithms and assess the performance of three separate imagers.

The FY 2005 effort will be used to develop a real time processor for the system.

R9332	FY 2004	FY 2005
SCOUT (LPI) RADAR DEMONSTRATION	2,410	0

This effort completed modifications to the timing and waveform subsystem for zoom modes modification in the Scout radar system.

R9481	FY 2004	FY 2005
C BAND ACTIVE ARRAY RADAR	0	6,340

This effort will develop affordable Transmit and Receive modules and radar at C-Band for small ships, where high performance S and X band arrays are not required.

R9482	FY 2004	FY 2005
HORIZON EXTENSION SURVEILLANCE SYSTEM (HESS)	0	2,081

This effort will develop a UAV based radar for extending the detection horizon against sea skimming missiles.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603271N PROGRAM ELEMENT TITLE: RF SYSTEMS ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9483	FY 2004	FY 2005
MINIATURE AUTOMATIC FUSION SPLICER	0	991

This effort will develop an automated splicer for military fiber optic cables onboard ships, aircraft, and land bases. The technology will develop electronic video image processing to perform automatic alignment and high voltage spark fiber optic welding to precisely align and fuse the optical fibers automatically.

R9484	FY 2004	FY 2005
PHOTONICS PROTOTYPING FACILITY	0	4,161

The effort will develop a prototyping process technology needed to fabricate prototype photonic integrated circuity for military and commercial requirements.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	98,595	88,239	56,434	58,833	62,427	58,850	59,586	60,874
C2297	MARINE CORPS WARFIGHTING LAB-CORE							
	40,726	39,196	35,640	34,882	37,349	33,219	33,950	34,724
C9154	MC ANTI-TERRORIST/FORCE PROTECTION (AT/FP) ATDS							
	14,709	4,953	0	0	0	0	0	0
R2223	MARINE CORPS ATD							
	28,316	21,503	20,794	23,951	25,078	25,631	25,636	26,150
R2995	C3RP							
	3,747	4,656	0	0	0	0	0	0
R9290	EXPEDITIONARY WARFARE WATER PURIFICATION							
	5,405	11,391	0	0	0	0	0	0
R9333	CENTER OF EXCELLENCE FOR ROBOTICS, ADV TECH DEMO							
	1,345	0	0	0	0	0	0	0
R9334	RAPID REPAIR, PORTABLE PRODUCTION (R2P2)							
	961	0	0	0	0	0	0	0
R9444	ADVANCED MINE DETECTOR SYSTEM/MAN PORTABLE QUADRAPOLE RESONANCE LANDMINE DETECTION							
	3,386	2,576	0	0	0	0	0	0
R9485	CRAFT INTEGRATED ELECTRONIC SUITE (CIES)							
	0	991	0	0	0	0	0	0
R9486	EXCALIBER UNMANNED TACTICAL COMBAT VEHICLE							
	0	991	0	0	0	0	0	0
R9487	PORTABLE METHANOL FUEL CELL							
	0	991	0	0	0	0	0	0

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)

R9488	STUDY TO IDENTIFY AND EVALUATE ALTERNATIVE FIXED-WING LIFT PLATFORMS						
	0	991	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: As the land warfare component of Naval Expeditionary Forces, the Marine Corps has unique and technologically stressing requirements resulting from its amphibious mission, Marine Air-Ground Task Force (MAGTF) organizational structure, reliance on maneuver, logistic sustainability, and intensive tempo of operations in diverse environments. Critical Marine Corps requirements addressed in this program element (PE) are Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR); Maneuver; Logistics; Human Performance, Training and Education; and Firepower. These are ongoing efforts to develop and demonstrate advanced technologies and system concepts in an operational environment. Multiple transitions into the Sub-system/Component Advanced Development phase are planned, as well as fieldable prototyping to reduce risk in System Concept Development and Demonstration. Joint service efforts are in line with Defense Technology Objectives (DTOs) and Joint Warfighting Objectives (JWOs). In addition, Marine Corps operational experimentation, warfighting concept experimentation, and conceptual operational assessment of emerging technologies are funded. 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 Intelligence, Surveillance and Reconnaissance (ISR) key transformational capabilities within Sea Strike and the enhanced Sea-borne Positioning of Joint Assets within Sea Basing.

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

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	90,110	58,222	60,506	59,393
Cong Rescissions/Adjustments/Undist. Reductions	0	-1,164	0	0
Congressional Action	0	31,200	0	0
Execution Adjustments	10,093	0	0	0
Non-Pay Inflation Adjustments	-80	0	330	443
Program Adjustments	0	-19	-5,482	-1,068
Rate Adjustments	0	0	1,080	65
SBIR Assessment	-1,528	0	0	0
FY 2006/2007 President's Budget Submission	98,595	88,239	56,434	58,833

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Since the FY 2005 President’s Budget submission, Marine Corps Warfighting Laboratory (MCWL) experimentation goals for the Sea Viking 2004 (SV04) Advanced Warfighting Experiment (AWE) have been revised, as explained in the two following paragraphs.

MCWL’s Sea Viking (SV) campaign is designed to transform the 1997 STOM concept into an operational reality and couple it with the emerging Distributed Operations (DO) concept to reshape expeditionary capabilities in keeping with the Naval Transformation Roadmap. DO builds on MCWL efforts begun in 1995 (Hunter Warrior) where the Lab employed infantry squads, as DO teams, to locate and defeat a conventional mechanized infantry unit and continues the effort under the SV umbrella. A series of experiments will evaluate whether a properly equipped and trained DO platoon or squad sized unit operating independently can: locate, observe, and accurately report enemy activity; and engage enemy forces with indirect and direct supporting fires, aggregate from individual squad positions, to conduct platoon offensive operations, and survive in the dispersed battlespace.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M
PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)

Schedule: C2297, MCWL: Worldwide contingency operations (i.e. Operation Iraqi Freedom (OIF) campaigns, humanitarian efforts, and others) have increased the operations tempo of United States (US) Operating Forces to the extent that their support of and participation in the MCWL AWEs Sea Viking 2004 and 2006 was substantially reduced. Events have been rescheduled and adjusted so that operational assessments may be conducted by operational units preparing to deploy to Iraq and subsequently in Iraq in order to accommodate troop availability.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: C2297 PROJECT TITLE: MARINE CORPS WARFIGHTING LAB-CORE

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
C2297 MARINE CORPS WARFIGHTING LAB-CORE	40,726	39,196	35,640	34,882	37,349	33,219	33,950	34,724

*Congressional Enhancement Funding for Project Albert ($4,105 and $3,349) is discussed in the Plus-Ups section of this PE's R2 exhibit.

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: MCWL is the centerpiece experimental test bed for the operational enhancements of the Marine Corps. MCWL, augmented by other Marine units, as its "test bed" organization, demonstrates the usefulness and necessity of integrating advanced concepts and new technological developments into the Operational Forces of the Marine Corps. Performing in the Joint and Marine Corps arenas, MCWL focuses on developing, assessing, and field evaluations of future operational and technological concepts and serves as the focal point for the enhancement/refinement of future warfighting capabilities.

Real-time exercises held in existing environments being used to simulate campaign theater (wartime) experiences "live experimentation" permits exploration of prototype and surrogate technologies in order to better refine equipment requirements and to identify Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities (DOTMLPF) initiatives needed to produce future capabilities. The use of modeling and simulation (M&S), both conducted within Service wargaming and virtual experiment venues (conducted in partnership with the Navy and Joint Forces Command (JFCOM)) will provide both a necessary Joint context for the Marine Corps Expeditionary Force Development System process as well as the opportunity to explore the implications of proposed future programs on seabased power projection capabilities. MCWL experimentation encompasses inquiries into multiple warfighting areas, including: Command, Control, Communications, and Computers (C4); ISR; Fires, Targeting, and Maneuver; Seabasing, Logistics, Combat Service Support (CSS), and Combat in Cities; and Warfighting Excellence.

Using operational forces, MCWL conducts AWEs supported by Limited Objective Experiments (LOEs), Limited Technical Assessments (LTAs), Wargames, and Studies. AWEs, LOEs, and LTAs examine discrete variables in as much isolation as can be achieved. Technologies assessed in LTAs are incorporated in LOEs while LOEs are building blocks from which resulting AWEs are constructed, (e.g. the Sea Viking experimentation series).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
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Under the guidance of the Commandant of the Marine Corps and in support of the Marine Corps Expeditionary Maneuver Warfare Capability List (ECL), MCWL's "build-up" phases culminate in actual AWE execution:

- Sea Viking 2004 (SV04): (FY 2002 through calendar year (CY) 2004) SV04 was a series of related events that constituted the overall Marine Corps Service Experimentation campaign through 2004. Its goals and objectives were based on guidance from the Commandant of the Marine Corps focusing on the seabased Marine Expeditionary Brigade (MEB), emphasizing execution of the Operational Maneuver from the Sea (OMFTS) and STOM concepts, in a Joint context. SV04 was significantly redefined in order to accommodate force deployments in support of OIF, with experimental objectives refocused on operational assessment by forward-deployed forces operating in highly dispersed units.
- Sea Viking 2006 (SV06): (FY 2005 through FY 2006) SV06 builds on the results, findings, and events of SV04 in order to further develop a true seabased capability within the context of emerging joint concepts. As with SV04, it uses an integrated "campaign" approach, is a key component of the Navy's Sea Trial process, and fully supports the Naval Transformation Roadmap. SV06 constitutes the principal exploratory effort into development of the future capabilities required for realization of the Naval Operational and Enhanced Network Seabasing concepts. In exploring the seabase, such issues as seabased fires are an integral part of joint fires in support of the expeditionary force conducting operational maneuvers. Live experimentation, both in simulated war zone and actual theater (i.e., Iraq) environments, permits both explorations of prototype and surrogate technologies in order to better refine equipment requirements and to identify DOTMLPF initiatives needed to produce future capabilities.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
OPERATION IRAQI FREEDOM (OIF) SUPPORT	0	0	0	0

* $8,469 in FY 2004 AND $822 in FY 2005 are incorporated within the individual function areas where individual OIF II program efforts reside.

This section includes Operation Iraqi Freedom (OIF) II direct support costs only, through January 2005, in the following program areas: Over the Horizon/On the Move (OTH/OTM) Combat Operations Center (COC) communications support, Dust Palliative, Vehicle Hardening, Dragon Eye, Dragon Runner, Counter Shooter, BioSciences, Project Metropolis, Project Rifleman, Center for Emerging Threats and Opportunities (CETO), enhanced reconnaissance

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: C2297 PROJECT TITLE: MARINE CORPS WARFIGHTING LAB-CORE

team, Telepresent Rapid Aiming Platform (TRAP), and miscellaneous micro purchases. Each of these programs is discussed within the applicable functional areas listed below.

	FY 2004	FY 2005	FY 2006	FY 2007
COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS (C4)	12,646	8,570	10,332	9,677

This section encompasses all MCWL C4 related experimentation efforts.

FY 2004 Accomplishments:

- Continued experimental planning and C4 development support for the SV04 AWE.
- Initiated experimental planning and C4 development support for the SV06 AWE.
- Reduced development of information processing and further integration of capabilities into the C4 Lab facility.
- Redirected command and control (C2) integration and experimentation, to include Shared Net and Target Handoff System (Experimental) (THS(X)) efforts. Transitioned THS(X) to acquisition.
- Continued to conduct experiments and evaluate the performance of advanced C2 investigations and experiments for sea based C2 interoperability.
- Continued to evaluate the effectiveness of commercially available (off-the-shelf) technology for providing wireless connectivity to the tactical level.
- Expanded Over the Horizon (OTH) communications investigations in support of First Marine Expeditionary Force (I MEF) OIF deployment. These efforts centered on the overarching Expeditionary Tactical Communication System (ETCS) efforts coupled with OTM COC investigations.
- Completed initial technological assessment of an infantry battalion COC that is capable of operating OTM and deployable internally to helicopters and tilt-rotor aircraft in support of battalion level vertical assault operations.
- Continued experimentation and development of intra-squad radio systems.

FY 2005 Plans:

- Complete C4 planning and development support for the SV04 AWE.
- Continue C4 planning and development support for the SV06 AWE.
- Continue to develop information processing and to further integrate capabilities into the C4 Lab facility.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
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- Continue to conduct experiments and evaluate the performance of advanced C2 capabilities to support sea based C2 interoperability.
- Continue to evaluate commercially available wireless connectivity technologies.
- Continue OTH and OTM COC communications investigations in support of I MEF and Second MEF (II MEF) OIF deployments.
- Initiate extended/comprehensive technological assessment of an infantry battalion COC.
- Continue experimentation and development of intra-squad radio systems.
- Initiate investigation of tactics, techniques, technologies, and procedures (TTTPs) to achieve common tactical picture (CTP) for the Marine Air-Ground Task Force (MAGTF) conducting STOM.
- Initiate investigation of TTTPs for fires C2 in order to simplify operations/training and enhance interoperability of Joint, Navy, and Marine Corps systems.
- Initiate DO efforts, as they relate to C2 functions.
- Further evaluate promising C4 concepts.

FY 2006 Plans:

- Complete C4 planning and development support for the SV06 AWE.
- Initiate C4 planning and development support for the next major AWE.
- Continue to develop information processing and to further integrate capabilities into the C4 Lab facility.
- Initiate development and assessment of prototype Naval C2 systems and supporting techniques and procedures needed to give seabased forces operating ashore access to seabased fires.
- Continue to evaluate commercially available wireless connectivity technologies.
- Continue development and initiation of operational assessment of prototype OTH and OTM communications systems in concert with the Office of Naval Research (ONR) in order to determine the Beyond Line of Site communications requirements to enable MAGTF C2 of seabased forces operating ashore, focusing on the requirements of dismounted operations.
- Continue experimentation and development of intra-squad radio systems.
- Continue development and begin operational assessment of an infantry battalion COC that is capable of operating OTM and deployable internally to helicopters and tilt-rotor aircraft in support of battalion level vertical assault operations.
- Continue investigation of TTTPs to achieve CTP for MAGTF conducting STOM.
- Continue investigation of TTTPs for fires C2 in order to simplify operations/training and enhance interoperability of Joint, Navy, and Marine Corps systems.
- Continue DO efforts based on the results of initial experimentation with C2 for DO. A deploying unit will

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be trained and equipped for an extended field user evaluation as part of a seabased MAGTF.
- Complete experiments and evaluation of the performance of advanced C2 capabilities to support sea based C2 interoperability.
- Further evaluate promising C4 concepts.

FY 2007 Plans:

- Continue C4 planning and development support for an upcoming AWE.
- Continue to develop information processing and to further integrate capabilities into the C4 Lab facility.
- Continue to develop and assess prototype Naval C2 systems and supporting techniques and procedures needed to give seabased forces operating ashore access to seabased fires.
- Continue to evaluate commercially available wireless connectivity technologies.
- Continue development of prototype OTH and OTM communications systems focusing on the requirements of both surface and vertical assault forces.
- Continue experimentation and development of intra-squad radio systems.
- Continue development of an infantry battalion COC and explore the requirements for Expeditionary Fighting Vehicle (EFV) (formerly Advanced Amphibious Assault Vehicle (AAAV)) and Light Armored Vehicle (LAV) platforms.
- Continue investigation of TTTPs to achieve CTP for MAGTF conducting STOM.
- Continue investigation of TTTPs for fires C2 in order to simplify operations/training and enhance interoperability of Joint, Navy, and Marine Corps systems.
- Initiate a second iteration of DO experimentation to include a refinement of C4 requirements that includes advanced automated tactical systems as well as expansion to the company level.
- Initiate investigation of C2 capabilities needed to effect sustainment of forces conducting STOM and sustainment operations ashore from a seabased MAGTF.
- Further evaluate promising C4 concepts.

	FY 2004	FY 2005	FY 2006	FY 2007
INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR)	2,103	5,734	4,887	5,349

This section includes MCWL ISR related experimentation efforts involving enhanced reconnaissance; sensors; and unmanned ground and aerial vehicles.

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FY 2004 Accomplishments:

- Continued ISR support for the SV04 AWE.
- Initiated ISR planning for the SV06 AWE.
- Continued Dragon Eye Unmanned Aerial Vehicle (UAV) payload development, integration, experimentation, and refinement of tactics, techniques and procedures (TTPs). This included upgrades and repairs of damaged systems, being used in support of OIF. Dragon Eye is a back-packable system with modular payloads, designed to provide the small unit leader with an "over-the-hill" reconnaissance and surveillance capability.
- Continued Dragon Runner (DR) Mobile Ground Sensor (MGS) efforts. This included payload modification/multi-unit development efforts to integrate modified M203 launchers with an approved camera. Additional efforts included integration of an explosive material sensing device and trip wire detection unit to be mounted on the DR. These efforts not only support MCWL's experimentation program, but also support OIF efforts. DR is a ground mobile sensor (Unmanned Ground Vehicle (UGV)) that will be used by marine infantry battalions.
- Conducted efforts to support enhanced reconnaissance team functions, i.e., rifle and sight/scope evaluations used in support of OIF.
- Provided vehicles as surrogates for Internal Transportable Vehicles (ITVs) aboard cargo helicopters (CH)-53s, to better define the capabilities, configuration, and effective employment of the Vertical Maneuver Element (VME) concept.

FY 2005 Plans:

- Complete ISR support for the SV04 AWE.
- Continue ISR support for the SV06 AWE.
- Complete Dragon Eye UAV payload development, integration, experimentation, and refinement of TTPs.
- Initiate investigation of refocused Tier II UAV capabilities (known as Convoy Operations/Over the Horizon (OTH) Imagery investigations); initializing focus on a complete shipboard compatibility that requires minimal maintenance and time to train. Assess the operational employment of a prototype or surrogate UAV that can be employed from the seabase to conduct surveillance 150 nautical miles inland and detect threat elements day/night and report back to the seabase in order to define the UAV requirements of a seabased Marine Air-Ground Task Force (MAGTF) conducting joint forcible entry operations.
- Initiate efforts to define technological solution and TTPs for a UAV that provides support to convoy operations.
- Continue DR MGS efforts by repairing systems damaged while supporting OIF operations.
- Re-initialize Initiate Visual Intelligence, Surveillance, Tactical Alert System (VISTAS) (formerly known as

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Local Area Sensor System (LASS)) development efforts. This includes coding for C2, power interfacing to meet military specifications, software architecture, and layout of sensor system. Additional efforts include prototyping electro-mechanical upgrades to the shell and integrating electronics with outboard sensors. VISTAS is an unattended ground sensor system.
- Continue efforts to support enhanced reconnaissance team functions by enhancing the reconnaissance and surveillance capabilities to better enable Marine infantry units to locate enemy forces as part of DO experimentation.
- Continue purchase/evaluation of vehicles as surrogates for ITVs.
- Provide for Beam Hit Digital Down Link (DDL) capability. The Beam Hit program (a joint effort with the ONR) facilitates development of an Improvised Explosive Device (IED) change detection system. Efforts support OIF.
- Conduct additional IED deterrent investigations, including vehicle engine stopping systems comparative testing, to neutralize/counter vehicle borne IED threats and cell phone jamming technology testing.
- Conduct initial investigation into Rover Image Transfer Integration, which involves capabilities into Target Handoff System (Experimental) (THS(X)) to enable video capability from various air platforms.
- Conduct initial investigation into Precision Target Locator Designator (PTLD) Integration, which involves integration with the Strike Link (THS).
- Initiate and complete initial investigation, to include flight testing and evaluation, of Advanced Screen Saving Aviation Layered Tearaways (ASSALT). Efforts include AH-1 airframe adaptations.

FY 2006 Plans:

- Complete ISR support for the SV06 AWE.
- Initiate ISR support for the next major experimentation effort (AWE).
- Expand investigation of Convoy Operations/OTH Imagery UAV capabilities.
- Continue efforts to define technological solution and TTPs for a UAV that provides support to convoy operations and maneuver forces conducting STOM.
- Continue DR MGS efforts by designing and developing an infra-red pointer/illuminator and an internal Handheld Controller for remote monitoring/functionality of the sensor payload. In addition, perform robotic arm development.
- Complete VISTAS efforts by remodeling wireless data monitoring system, to include the associated electronics, software, and code writing.
- Continue efforts to enhance the reconnaissance and surveillance capabilities to better enable Marine infantry units to locate enemy forces as part of DO experimentation.
- Continue purchase/evaluation of vehicles as surrogates for ITVs.

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- Develop and complete concept and staff planning procedures that enable integration of MAGTF DO with Special Operating Force (SOF) operations.

FY 2007 Plans:

- Continue ISR support for the upcoming AWE.
- Continue investigation of Convoy Operations/OTH Imagery UAV capabilities.
- Based on results of SV06, continue to assess the operational employment of a prototype or surrogate UAV as part of the next major experimentation effort (AWE).
- Complete DR UGV efforts developing mini-pincher/grabber, wire cutting capability, and coaxial camera for the robotic arm.
- Continue efforts to enhance the reconnaissance and surveillance capabilities to better enable Marine infantry units to locate enemy forces as part of DO experimentation. This effort will examine the potential for DO teams to employ advanced ground sensors, UGVs, and UAVs.
- Continue purchase/evaluation of vehicles as surrogates for ITVs.
- Continue efforts to define training and equipment capabilities for ISR conducted during STOM and DO.

	FY 2004	FY 2005	FY 2006	FY 2007
FIRES, TARGETING, AND MANEUVER	4,441	4,456	4,587	3,667

This section includes MCWL experimentation efforts in the areas of fires, targeting, and maneuver.

FY 2004 Accomplishments:

- Continued first Dragon Fire II concept demonstrator development. This effort is an augmentation to the Mobile Fire Support System (MFSS) Congressional enhancement (Project C9154).
- Completed THS(X) development and transition to the Marine Corps Systems Command (MCSC). The THS(X) program investigated and conducted experiments in aviation and fire support technologies that could lead to increased accuracy and effectiveness of close air and fire support missions while also reducing the possibility of fratricide.
- Concluded engineering support as well as upgrades and assessment of the current TRAP systems design. This included writing standard operating procedures for rocket propelled grenade (RPG) live-fire testing, performing laser safety classifications, and evaluation of the Guardian Watch Perimeter Security System and its Potential Application to the TRAP. These efforts, in addition to supporting MCWL experimentation efforts,

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support OIF functions. These efforts augmented the TRAP Congressional enhancement (Project C9154).
- Conducted Digital Fires Coordination Device (DFCD) development, by providing concept demonstrator design and version I system delivery for participation in the SV04 AWE. The DFCD program designed a concept demonstrator of an advanced fire support coordination software system hosted in a ruggedized computer (handheld or laptop) to give the forward elements of a STOM force the ability to control and deconflict fires. The system is based on the THS(X) software and was designed to give the advance force commander a simplified and compact system to develop and transmit coordinating measures, target lists, fire plans, fire missions, and warnings. This program transitioned with THS(X) to MCSC.
- Completed M3M machine gun mounted on helicopter platforms experimentation.
- In support of OIF II and MCWL sponsored experimentation, initiated Counter Shooter testing – First Marine Expeditionary Force (I MEF) Limited Technical Assessment (LTA) on the Gunfire Detection and Location (GDL) System.
- Also in support of OIF, purchased a Lightweight Counter Mortar Radar (LCMR) to conduct investigation/ experimentation. LCMR is a technology that detects and locates hostile firing systems, out to a range of 7,000 meters.
- Initiated efforts to develop, purchase, and test 12 gauge rounds (fragmenting and armor piercing) for fin-stabilization and penetration.

FY 2005 Plans:

- Complete first Dragon Fire II concept demonstrator. This includes the gun assembly, safety release testing/documentation, ammunition purchase, and firing tests.
- Complete development of modular Dragon Fire II design for fire support systems using the Dragon Fire/Light Armored Vehicle (LAV) test-bed.
- Continue LCMR investigation/experimentation, to include research and testing of improved cooling units.
- Initiate investigations into highly mobile, internally transportable counter-fire radar to support a vertical maneuver element (VME).
- Initiate investigation of capabilities to enhance tactical mobility of a VME.
- Complete 12 gauge ammunition efforts.
- Expand/conclude counter shooter efforts by purchasing/testing additional systems.
- Conduct Heavy Machine Gun Initiative (HMGI) related design, fabrication, and testing of prototype advanced mounts; and purchase and test grenade machine guns as well as quick change barrels. HMGI is a joint initiative with the Office of Naval Research (ONR) and the Naval Surface Warfare Center (NSWC) to develop a heavy machine gun Advanced Technology Demonstrator (ATD).

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- Initiate efforts to develop and assess STOM tactics, techniques, and procedures (TTPs).
- Initiate efforts to develop and assess planning and execution TTPs to exploit/examine EFSS in support of forces conducting STOM.
- Initiate investigation of the potential for Marine Infantry at the squad and team level with enhanced equipment and training to terminally control indirect and aviation fires.

FY 2006 Plans:

- Continue LCMR investigation/experimentation.
- Continue investigations into highly mobile, internally transportable counter-fire radar to support a VME.
- Continue investigating capabilities to enhance tactical mobility of a VME.
- Continue to examine/develop EFSS prototypes focusing on operational assessment of a modular capability employed by both foot and LAV mobile forces.
- Continue efforts to develop and assess STOM TTPs.
- Continue efforts to develop and assess planning and execution TTPs to exploit EFSS in support of forces conducting STOM.
- Complete investigation of the potential for Marine Infantry at the squad and team level with enhanced equipment and training to terminally control indirect and aviation fires.

FY 2007 Plans:

- Continue LCMR investigation/experimentation.
- Continue investigations into highly mobile, internally transportable counter-fire radar to support a VME.
- Continue investigating capabilities to enhance tactical mobility of a VME.
- Continue to examine/develop EFSS prototypes.
- Continue efforts to develop and assess STOM TTPs.

	FY 2004	FY 2005	FY 2006	FY 2007
SEABASING, LOGISTICS, COMBAT SERVICE SUPPORT (CSS), AND COMBAT IN THE CITIES	5,836	5,827	3,454	3,539

This section includes MCWL experimentation efforts involving seabasing, logistics, CSS, urban combat, medical, as well as training and education.

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FY 2004 Accomplishments:

- Continued to search for, evaluate, and assess potential solutions to enhance seabased sustainment capabilities. This effort explored the use of C2, fires, maneuver, and sustainment required of a Marine Combat Service Support Detachment (MCSSD) in support of a Marine Air-Ground Task Force (MAGTF) Operational Maneuver from the Sea (OMFTS) operation.
- Continued effort with experimental vehicles to enable sustainment of forces in an OMFTS environment. This included titanium door and Explosive Resistant Coating (ERC) testing on High Mobility Multi-purposed Wheeled Vehicles (HMMWVs) and Medium Tactical Vehicles (MTVs). In addition, ballistic properties testing and modeling of various materials was performed. These tasks supported MCWL experimentation efforts, as well as, OIF vehicle hardening efforts.
- Initiated efforts to harden vehicles against rocket propelled grenades (RPGs) and warhead fragments.
- Continued development of MCM initiative to develop and assess the TTTPs surrounding a Marine Expeditionary Unit (MEU) MCM Capability Set. This effort supports MCWL experimentation and OIF.
- Completed testing of various Counter Mine Detection systems.
- Continued MOUT experimentation efforts to include Project Metropolis and Project Rifleman. Efforts included Stability and Support Operations (SASO) and training (including Squad Automatic Weapon (SAW) Simunition Kit and ammunition purchases). In addition, vehicle armor and Rocket Propelled Grenade (RPG) testing/assessments were conducted. These efforts not only supported MCWL sponsored experimentation, but OIF as well. Project Metropolis was the definitive multi-year experiment designated to create realistic warfighting allowing Marines to shoot, move, and communicate as they accomplished missions during MOUT. Project Rifleman, a subset of Project Metropolis, is a project conducting experimentation with the TTTPs of the individual Marine to better enable him/her to fight and survive in expeditionary combat environments.
- Continued to investigate individual equipment to enhance Marines' survivability and combat effectiveness. This effort included the purchase of protective face masks/shields and lower torso gear which not only supported MCWL experimentation, but OIF as well.
- Maintained Marine Corps and Special Operations Command (SOCOM) TTTPs collaboration.
- Expanded High Speed Connector (HSC) (formerly Joint High Speed Vessel (JHSV)) development, integration, and experimentation by assisting the Joint Operations Center (JOC) with program efforts to explore the concepts and capabilities with commercially available advanced hull and propulsion technology.
- Continued bio-science (medical) initiatives. Specific efforts included: Tactical Medical Coordination System (TacMedCS), which is a prototype system to enhance Casualty Evacuation (CASEVAC) tracking via individual casualty locator; Combat Trauma Registry (CTR) efforts, which is the raw data collection, entering of pertinent data into the CTR, performing analysis, and reporting on casualties treated during Operation

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Enduring Freedom (OEF) as well as the OIF campaigns; and Advanced First Aid Limited Technical Assessment (LTA), which consists of addressing the major need for systematic, scientific study of combat casualties. All three of these efforts support MCWL sponsored experimentation, as well as OIF.
- Also known as Dust Palliative development, provided for the development of a suitable low-maintenance lightweight replacement or augmentation to current AM-2 matting to facilitate the construction or enhancement of Forward Operating Bases (FOBs). This effort supported MCWL sponsored experimentation, as well as OIF.
- Initiated investigations into the Electronic Control Active Suspension System (ECASS), which is a system that has the capability to adjust itself continuously to changing road conditions. This was a joint venture with the ONR.

FY 2005 Plans:

- Continue to search for, evaluate, and assess potential solutions to enhance seabased sustainment capabilities.
- Complete experimental vehicle effort to include assessment of Military Utility, associated fuel costs, environmental impact surveys of experiment sites, internal aerial transportability certification, and loaders/attachments feasibility.
- Continue limited vehicle hardening efforts.
- Refurbish/purchase Flyer ITVs to collect data during experimentation with insertion of motorized Marine infantry. In addition, helicopter certification will be obtained for the Flyer vehicles.
- Complete MCM development/experimentation efforts.
- Continue MOUT experimentation efforts.
- Continue to investigate individual equipment to enhance Marines' survivability and combat effectiveness.
- Continue to maintain Marine Corps and SOCOM TTTPs collaboration.
- Continue HSC efforts.
- Continue bio-science (medical) initiatives, to include CTR; purchasing/evaluating Dragon Doc/Medical Assault Packs (MAP), which are upgraded Field Corpsman treatment items; and providing for Mini Forward Resuscitative Surgery System (FRSS) capability study using a proven method to provide medical support for STOM/DO.
- Expand ECASS investigations by providing for baselined data modeling as well as development and build of an initial prototype.
- Initiate efforts to identify the organization, equipment, and tactics required for CSS elements operating ashore on unsecured LOC to facilitate sustaining a seabased MAGTF conducting STOM.

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FY 2006 Plans:

- Continue to search for, evaluate, and assess potential solutions to enhance seabased sustainment capabilities.
- Continue experimental vehicle testing/experimentation.
- Continue limited vehicle hardening efforts.
- Conduct, as part of SV06, efforts to examine technologies that support sustainment of seabased forces ashore by enhancing distribution and reducing logistics footprint ashore. Initial focus of effort will be on fuel and water.
- Continue MOUT experimentation efforts.
- Continue to investigate individual equipment to enhance Marines' survivability and combat effectiveness.
- Continue to maintain Marine Corps and SOCOM TTTPs collaboration by continuing conceptual development of the organization, equipment, and TTPs for CSS elements operating ashore on unsecured LOC. The results of 2005 and 2006 workshops and wargames will drive the development of prototypes and processes for subsequent live experimentation.
- Reduce HSC experimentation/investigation efforts.
- Continue bio-science (medical) initiatives. Continue to develop and assess prototype casualty tracking and enroute care systems focusing on how the Marine Corps maintains medical information; and tracks and treats casualties during live force experimentation. Also continue Dragon Doc/MAP, Mini FRSS, and complete CTR efforts.
- Complete Dust Palliative efforts by providing application system equipment and performing liquid polymer testing.
- Continue ECASS investigations/development/experimentation efforts
- Continue efforts to identify the organization, equipment and tactics required for CSS elements operating ashore on unsecured LOC to facilitate sustaining a seabased MAGTF conducting STOM.

FY 2007 Plans:

- Continue to search for, evaluate, and assess potential solutions to enhance seabased sustainment capabilities.
- Continue experimental vehicle testing/experimentation.
- Continue limited vehicle hardening efforts.
- Continue to examine technologies that support sustainment of seabased forces ashore by enhancing distribution and reducing logistics footprint ashore.

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- Continue to assess capability packages consisting of equipment, organization changes and supporting TTPs for CSS elements operating ashore on unsecured LOCs.
- Continue MOUT experimentation efforts.
- Continue to investigate individual equipment to enhance Marines' survivability and combat effectiveness.
- Transition HSC program to Marine Corps Systems Command (MCSC).
- Continue bio-science (medical) initiatives.
- Continue to develop and assess prototype casualty tracking and enroute care systems; Dragon Doc/MAP enhancements; and Mini FRSS analysis.
- Continue ECASS investigations/development/experimentation efforts
- Continue efforts through operation experimentation to identify the organization, equipment and tactics required for CSS elements operating ashore on unsecured LOC to facilitate sustaining a seabased MAGTF conducting STOM.

	FY 2004	FY 2005	FY 2006	FY 2007
MARINE CORPS WARFIGHTING LABORATORY (MCWL)OPERATIONS (SUPPORT)	6,273	6,860	7,758	7,875

MCWL Operations (Support) efforts include overall MCWL experimentation doctrine, planning, analysis, data collection, as well as transition efforts.

FY 2004 Accomplishments:

- Completed SV04 AWE planning and technology investigations.
- Initiated SV06 AWE planning and technology investigations.
- Maintained Strategic Planning efforts through the location, development, and evaluation of advanced warfighting operational and organizational concepts and related enabling technologies.
- Continued to synthesize results and lessons learned into proposed DOTMLPF recommendations for the Marine Corps.
- Continued pursuing transition avenues for maturing TTTPs.
- Continued to provide technical, strategic, and managerial support to Marine Corps Experimentation.
- Completed S&T Common Operational Picture (COP) (formerly known as Science and Technology Operations Information Center (STOIC)) development, focusing on linking S&T communities.
- Maintained overall analysis and reporting of experimentation efforts, analytical experimental design support, and a capability to provide ad-hoc analysis support as required.

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- Provided funding to support Force Battle Lab effort – Third Marine Expeditionary Force (III MEF) experimental shooting house training device completion. Efforts permitted enhanced MOUT, Close Quarters Battle training.
- Continued to support tactical instrumentation capability that provides battlespace instrumentation for experimentation.
- Continued to provide overall analysis and reporting of experimentation efforts, provide analytical assistance during experiment design, and maintain an ad-hoc analysis capability.
- Continued to provide technical, strategic, and managerial support to Marine Corps Experimentation.
- Continued efforts to improve upon the automated data collection system (Integrated Global Positioning System Radio System (IGRS) II).

FY 2005 Plans:

- Continue SV06 AWE planning and technology investigations.
- Continue Strategic Planning efforts.
- Continue to synthesize results and lessons learned into proposed DOTMLPF recommendations.
- Continue pursuing transition avenues for maturing TTTPs.
- Continue to provide technical, strategic, and managerial support to Marine Corps Experimentation.
- Initiate Electronic File (eFile) (formerly known as S&T COP) development, focusing on file maintenance and linking to S&T communities.
- Continue to provide technical, strategic, and managerial support to Marine Corps Experimentation.
- Continue to provide overall analysis and reporting of experimentation efforts, provide analytical assistance during experiment design, and maintain an ad-hoc analysis capability.
- Continue to provide for emerging Force Battle Lab efforts.
- Continue tactical instrumentation/data collection efforts.
- Complete IGRS II data collection/reconstruction efforts.

FY 2006 Plans:

- Complete SV06 AWE planning and technology investigations.
- Initiate planning for the next AWE.
- Continue Strategic Planning efforts.
- Continue to synthesize results and lessons learned into proposed DOTMLPF recommendations.
- Continue pursuing transition avenues for maturing TTTPs.

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- Continue to provide technical, strategic, and managerial support to Marine Corps Experimentation.
- Continue eFile efforts.
- Continue to provide overall analysis and reporting of experimentation efforts, provide analytical assistance during experiment design, and maintain an ad-hoc analysis capability.
- Continue to provide for emerging Force Battle Lab efforts.
- Continue tactical instrumentation/data collection efforts.

FY 2007 Plans:

- Continue planning and technology investigations for next AWE.
- Continue Strategic Planning efforts.
- Continue to synthesize results and lessons learned into proposed DOTMLPF recommendations.
- Continue pursuing transition avenues for maturing TTTPs.
- Continue to provide technical, strategic, and managerial support to Marine Corps Experimentation.
- Continue eFile efforts.
- Continue to provide overall analysis and reporting of experimentation efforts, provide analytical assistance during experiment design, and maintain an ad-hoc analysis capability.
- Continue to provide for emerging Force Battle Lab efforts.
- Continue tactical instrumentation/data collection efforts.

	FY 2004	FY 2005	FY 2006	FY 2007
WARFIGHTING EXCELLENCE	5,303	4,381	4,622	4,775

This section includes MCWL experimentation efforts in the areas of wargaming, the Center for Emerging Threats and Opportunities (CETO), and Project Albert.

FY 2004 Accomplishments:

- Continued Executive Agent (EA) responsibilities for joint Title Ten (X)/Joint Concept Development and Experimentation (JCDE) programs such as Unified Quest, Unified Course, and Unified Engagement. EA responsibilities are comprehensive, e.g., planning, training, and assessing for critical importance to the USMC. Title X wargames generally address future capabilities in the context of core Title X readiness responsibilities and include participation in other service Title X wargames, as well as, planning and executing the Marine Corps Title X Expeditionary Warrior (EW) program. JCDE efforts include the co-sponsored

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Marine Corps/JFCOM Joint Urban Warrior (JUW) program designed to support JFCOM Joint Urban Operations (JUO) efforts.
- Continued EW as the Marine Corps' Service, or Title X Wargaming Program, consisting of a combination of war games, seminars, workshops, and related events designed to address issues of particular concern to the senior leadership of the Marine Corps, (e.g., the cooperation and interoperability of USMC and Special Operations Command (SOCOM) forces in the context of the Global War on Terrorism (GWOT)).
- Continued the management and oversight of non Title X wargaming to include the highly visible Office of the Secretary of Defense's (OSD's) Net Assessment Transformation War Game series and the SOCOM wargaming series.
- Continued the partnership, JUW, between the USMC and JFCOM on joint and combined urban operations concept development and experimentation (CD&E). JUW is focused on the integration of the full spectrum of advanced operational concepts, organizational innovations, technologies, and other transformational opportunities in complex urban operations.
- Continued to provide CETO support. CETO is a partnership between the Marine Corps Combat Development Command (MCCDC) 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 USMC operating forces. (Note: Although administratively attached to MCWL, CETO is operationally controlled by the MCCDC). A small portion of the CETO effort supported Operation Iraqi Freedom (OIF) by providing limited Operating Force training.
-Re-energized Joint Experimentation Cell efforts by conducting Joint Warfighting Capability Assessments (JWCAs) and participating on Functional Capability Boards (FCB), as well as providing Joint Integration and Implementation Planner support to the Marine Corps.

FY 2005 Plans:

- Continue EA responsibilities for joint Title X/JCDE programs.
- Continue EW efforts.
- Continue the management and oversight of non Title X wargaming.
- Continue the partnership, JUW, between the USMC and JFCOM on joint and combined urban operations CD&E.
- Re-initiate SEAWAY logistical efforts by providing support for a broad range of wargames, e.g., EW, JUW, and SV.
- Re-define CETO effort to support the development of future warfighting concepts and related experimentation by researching and assessing current, emerging, and future world threats, opportunities, and strategic settings, to include adversarial threats and strategies; regional geographical, environmental, and economic

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conditions; and scenarios involving the potential deployment and employment of Naval forces. CETO will conduct research and make recommendations for developing “change strategies” to enable the Marine Corps to institutionalize and field future warfighting capabilities across the Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities (DOTMLPF) spectrum.
- Continue Joint Experimentation Cell efforts.
- Initiate the Joint Force Protection (JFP) Advanced Concept Technology Demonstration (ACTD) to provide warfighters with a simple, timely, comprehensive understanding of deployment and distribution information. ACTDs are intended to rapidly field needed joint capabilities by employing emergent mature technologies matched with innovative operational concepts. Marine Corps participation in ACTDs enables experimental efforts to leverage OSD research, development, test, and evaluation (RDT&E) and other Service funding for the development of systems and concepts likely to transition to acquisition programs of record and joint concept of operations. JFP plans to increase the Warfighter’s ability to see and influence the identification, sourcing, projection and integration of force capabilities employed to achieve operational effects in the theater Joint Operating Area.

FY 2006 Plans:

- Continue EA responsibilities for joint Title X/JCDE programs.
- Continue EW efforts.
- Continue the management and oversight of non Title X wargaming.
- Continue the partnership, JUW, between the USMC and JFCOM on joint and combined urban operations CD&E.
- Continue CETO operations.
- Continue Joint Experimentation Cell efforts.
- Continue JFP efforts to provide warfighters with a simple, timely, comprehensive understanding of deployment and distribution information.
- Conduct investigations into other promising ACTD efforts.

FY 2007 Plans:

- Continue EA responsibilities for joint Title X/JCDE programs.
- Continue EW efforts.
- Continue the management and oversight of non Title X wargaming.
- Continue the partnership, JUW, between the USMC and JFCOM on joint and combined urban operations CD&E.
- Re-initiate SEAWAY logistical efforts by providing support for a broad range of wargames.

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- Continue CETO operations.
- Continue Joint Experimentation Cell efforts.
- Continue JFP efforts to provide warfighters with a simple, timely, comprehensive understanding of deployment and distribution information.
- Continue investigations into other promising ACTD efforts.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E: The Navy’s 6.1 program contributes indirectly to this effort.
PE 0602131M Marine Corps Landing Force Technology

NON-NAVY RELATED RDT&E: Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2a

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PROJECT NUMBER: R2223 PROJECT TITLE: MARINE CORPS ATD

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R2223 MARINE CORPS ATD	28,316	21,503	20,794	23,951	25,078	25,631	25,636	26,150

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Critical Marine Corps requirements/imperatives addressed in this Project are: Maneuver; Firepower; C4ISR; Logistics; Human Performance, and Training and Education. 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 Maneuver on land is to become a functional component of Naval Expeditionary Maneuver Warfare (EMW). Maneuver, supported by 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 MOUT, and in OOTW; 3) and warfighting experimentation. By providing the technologies to enable these capabilities, this project supports the goals and objectives of the Strike, Littoral Warfare and Surveillance Joint Mission Areas. These are ongoing efforts to develop and demonstrate advanced technologies and system concepts in an operational environment.

In addition, this project supports the goals and objectives of the Littoral Combat/Power Projection Future Naval Capability (FNC). Through 2005 the focus of the FNC efforts has been on satisfying technology gaps related to Power Projection and Littoral Combat. As the products of these efforts are transitioned to acquisition programs of record, the focus of the FNC within this PE in FY 2006 and beyond will be on technology related to Urban, Asymmetric, and Expeditionary Operations (UAEO). The UAEO Capability Gap is a science and technology developmental area that is of the highest importance to Marine Corps operations in Iraq and Afghanistan. The UAEO Capability Gap is one of 25 prioritized Capability Gaps (prioritized by OPNAV N-6/7 and the Marine Corps Combat Development Command) that are made up of Enabling Capabilities (ECs) and supporting products. The UAEO technology gap is being pursued as part of an overall effort that addresses the Sea Strike Capability Gap.

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B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
MANEUVER	1,954	5,903	7,134	6,835

This activity demonstrates technologies to enhance battlespace mobility and survivability through analysis and development of demonstration hardware. Technology Maneuver Thrust Area focuses on the development, demonstration, and transition of technologies that will increase the warfighting capabilities and effectiveness of current and future Marine Corps maneuver systems. This Thrust aims at capturing emerging and “leap ahead” technologies in the areas of mobility, materials, propulsion, survivability, durability, signature reduction, and modularity. A concentrated effort has been made in the development of modeling and simulation “tools” that integrate many different physics based modeling systems with rigorous operational analysis simulations to accurately define a system’s performance characteristics. These tools will aid in defining the trade space for emerging technologies and assist in providing the Program Manager insight and guidance into pursuing future technologies. This activity also focuses on advanced development and demonstration of MCM technologies enabling MCM capabilities in synchronization and speed of mine detection, organic neutralization, assault breaching, tactical clearance, proofing, marking, and Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4I) operations. MCM encompasses countermine, counter-IED, and counter-unexploded Ordnance (UXO) enabling technologies.

This activity includes efforts for the Advanced Mine Detector (AMD). AMD will combine multiple sensing technologies to detect explosives in antipersonnel and antitank mines, a key capability due to the worldwide proliferation of low and non-metallic mines. AMD will apply nuclear quadrupole resonance (NQR) science to confirm the presence of explosives.

In FY 2005 and beyond, the MCM efforts are reflected under the Maneuver activity.

FY 2004 Accomplishments:

- Completed development of very low power stochastic NQR pulse sequencing techniques for detection of multiple lines of Trinitrotoluene (TNT).
- Completed development of advanced NQR techniques for improved TNT detection, to include pulse sequences that are less sensitive to temperature variations, and examine the possibility of increasing TNT SNR by hybrid NQR/Nuclear Magnetic Resonance techniques.

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- Completed reduction of acoustic ringing by developing coils with a reduced electric field and composite RF pulses.
- Completed TNT characterization by determining whether observed differences in TNT formulations represent mixtures of pure orthorhombic and monoclinic crystalline forms, or twinning effects of the monoclinic phase.
- Completed development of Marine Air Ground Task Force (MAGTF) Expeditionary Family of Fighting Vehicle (MEFFV) concept designs.
- Completed designs and built technology demonstrators of Tactical Unmanned Ground Vehicles (TUGV) to demonstrate advanced unmanned capabilities in the areas of mobility, survivability, Command and Control (C2), ISR (intelligence, surveillance, and reconnaissance), and lethality (lethal and non-lethal systems.
- Transitioned TUGV to the Marine Corps Systems Command for acquisition.
- Continued exploration of methods to compensate for the inhomogeneous radio-frequency (RF) field of surface coils, for optimizing Signal to Noise Ratio (SNR) for varying inspection depths.
- Continued to improve Radio Frequency Interference (RFI) mitigation techniques and hardware, by considering coil designs, alternate RFI reference antenna designs, correlation between channels, and mitigation algorithms.
- Continued extension of characterization to a broader range of TNT sources, and to tetryl.
- Initiated NQR technology integration efforts with a Ground Penetrating Radar (GPR) and Electro Magnetic Induction EMI system.

FY 2005 Plans:

- Continue refinement of RFI mitigation, SNR enhancement, and acoustic ringing techniques.
- Continue extension of characterization to a broader range of TNT sources, and to tetryl.
- Continue NQR technology integration efforts with a GPR and EMI system.
- Initiate development of technology for the Tactical Unmanned Ground Vehicle (TUGV) by applying advanced data and video signal processing to enhance operator/machine interaction for improved performance, safety & mobility at greater distances and in cluttered environments.
- Initiate Advanced Electronically Controlled Active Suspension System (ECASS) development efforts for High Mobility Multi-Purpose Wheeled Vehicle (HMMWV) and future USMC vehicles (MEFFV).

FY 2006 Plans:

- Complete NQR technology integration efforts with a GPR and EMI system.
- Continue Advanced ECASS development in support of HMMWV, MEFFV and other Light Armored Vehicles.

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- Continue development of data transmission technology for the TUGV.
- Transition the AMD effort (which includes extension of characterization to a broader range of TNT sources, and to tetryl) to the Marine Corps System Command.
- Continue refinement of RFI mitigation, SNR enhancement, and acoustic ringing techniques.
- Initiate development of effective corrosion control techniques & materials to apply to broad range of USMC vehicles & applications.
- Initiate Land MCM S&T detection initiatives approved to address close-in and standoff detection deficiencies within the MAGTF.
- Initiate Land MCM neutralization initiatives approved to address assault breaching deficiencies within the MAGTF.

FY 2007 Plans:

- Continue Advanced ECASS development
- Continue advanced technology development for the TUGV.
- Continue development of effective corrosion control techniques & materials to apply to broad range of USMC vehicles & applications.
- Continue Land MCM S&T detection initiatives to address close-in and standoff detection deficiencies within the MAGTF.
- Continue Land MCM S&T neutralization initiatives to address assault breaching deficiencies within the MAGTF.
- Initiate S&T efforts addressing MEFFV technology investment plan.
- Initiate advanced armor concepts development for Marine Corps platforms from 6.2 program.

	FY 2004	FY 2005	FY 2006	FY 2007
LITTORAL COMBAT/POWER PROJECTION (LC/PP)	11,458	5,308	2,887	3,604

The goal of the LC/PP 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 warfighting functions: Command, Control, Intelligence, ISR, Fires, Maneuver, Sustainment, and Force

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Protection. This activity includes support to the FNC Enabling Capability for Improvised Explosive Devices spirals 1 and 2, Modular Scalable Weapon, Position Location Information, Advanced Naval Fires Technology spiral 1, Dynamic Target Engagement and enhanced sensor capabilities, and Hostile Fire Detection and Response spiral 1.

FY 2004 Accomplishments:

- Completed a study of how SIGINT operators can be tested against realistic signal environment prior to deploying.
- Continued development of Sensitive Compartmented Information (SCI) communication specifications for a Marine Corps Signal Intelligence (SIGINT) System that enables advanced data parsing, fusion and knowledge dissemination and transition to acquisition.
- Continued development of improved lightweight computational fire control interface Expeditionary Fires Support System (EFSS) technology.
- Continued development of advanced weapon materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability. Transitioned Isogrid topology for application on the M777 Howitzer trails.
- Continued to develop, integrate and test additional functionality for expeditionary maneuver warfare (STOM) planning software.
- Initiated development of the Measurement and Signal Intelligence (MASINT) core sensor fusion Tactical Remote Sensor System (TRSS) architecture.
- Initiated development of algorithms for identifying multi-source intelligence (INT) visualization by Radio Frequency (RF), magnetic, acoustic, or other emissions signature.
- Initiated development of a system that provides for stationary RF emitter tracking in high multi-path urban environment using one mobile and one fixed collector.
- Initiated development of innovative relay (Beyond Line of Sight (BLOS)) technology to provide secure communication during STOM.
- Initiated efforts to provide an obstacle avoidance capability for the Expeditionary Fighting Vehicle (EFV).
- Initiated design integration and demonstration of hostile fire detection and counterfire system (GUNSLINGER) spiral 1.

FY 2005 Plans:

- Complete development and begin transition of expeditionary maneuver warfare (STOM) planning and decision-

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making tools for Marine ground forces.
- Complete the development of multi-source INT visualization algorithms to increase the efficiency and effectiveness of raw sensor data to actionable intelligence and commence testing/demonstration. (FY 06 effort funded by PE 0603782N).
- Continue development of tools and technologies to support Marine Corps ISR efforts (MASINT/TRSS) in remote sensor integration within the Distributed Common Ground/Surface System (DCGS).
- Continue efforts to provide urban direction finding for RF emitters from moving platforms.
- Continue development of improved fire control systems technologies to EFSS artillery and mortar systems.
- Continue design and development of advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability.
- Continue efforts to provide an obstacle avoidance system on the EFV by conducting open ocean testing of a brassboard design. Transition to technology to acquisition program of record.
- Continue design, integration and demonstration of hostile fire detection and counter-fire system (GUNSLINGER).
- Continue development of innovative relay (BLOS) technology through integration and demonstration of secure mobile network/wireless local area network (LAN) communication technologies. Transition EFV high data rate secure wireless communication connection to acquisition program of record.
- Initiate development of improved lightweight computational fire control interface technology.

FY 2006 Plans:

- Complete development and transition technology to provide an obstacle avoidance system on the EFV acquisition program of record.
- Continue efforts to provide urban direction finding of RF emitters from moving platforms.
- Continue development of tools and technologies to support Marine Corps ISR efforts (MASINT/TRSS) in remote sensor integration within the Distributed Common Ground/Surface System (DCGS)
- Continue design and development of advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability.
- Continue development of improved lightweight computational fire control interface technology.
- Continue development of improved fire control systems technologies to EFSS artillery and mortar systems.
- Continue effort to incorporate advanced target acquisition target hand off technologies to reduce sensor to shooter loop and improve target location.
- Continue investigation of ammunition packaging techniques to lower weight and have the packaging provide additional use on the battlefield. (Previous and concurrent funding provided by PE 0602131M)

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- Continue integration of hostile fire detection and counter-fire system (GUNSLINGER).
- Continue development of innovative relay (BLOS) technology through integration and demonstration of secure wireless networks/secure wireless LAN communication technologies.

FY 2007 Plans:

- Complete efforts to provide urban direction finding of RF emitters from moving platforms.
- Complete effort to incorporate advanced target acquisition target hand-off technologies to reduce sensor to shooter loop and improve target location.
- Complete investigation of ammunition packaging techniques to lower weight and have the packaging provide additional use on the battlefield.
- Complete development and transition improved lightweight computational fire control interface (EFSS) technology.
- Complete development and transition advanced weapons materials for use in artillery and mortar systems to reduce weight while maintaining strength, and increasing operational life and capability.
- Continue development of tools and technologies to support Marine Corps ISR efforts (MASINT/TRSS) in remote sensor integration within the DCGS.
- Continue development and demonstrate hostile fire detection and counter-fire system (GUNSLINGER).
- Continue development of landmine countermeasure insensitive munitions technology. (Previous efforts funded by PE 0602131M)
- Continue development of innovative relay (BLOS) technology through integration and demonstration of secure wireless networks/secure wireless LAN communication technologies.

	FY 2004	FY 2005	FY 2006	FY 2007
HUMAN PERFORMANCE, TRAINING & EDUCATION	3,998	2,778	2,726	3,623

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

FY 2004 Accomplishments:

- Completed demonstration technologies available for prototype of an Anti-Terrorism (AT) Tactical Decision Simulation (TDS) for use by the 4th Marine Expeditionary Brigade Marine Security Force.

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- Completed demonstration of technologies available for prototype of Logistics Combat Services Support Element (CSSE) TDS for use in the Logistics Officer's Course at the Logistics School.
- Completed Ground Combat Element (GCE) Platoon Tactical Decision Game (TDG), Close Combat Marine.
- Continued development and evaluation of low-cost, dynamic cognitive skills training tools (tactical decision simulations) that cut across every echelon for individual, groups, and groups of groups.
- Continued demonstration and evaluation of a prototype of Video Flashlights capability for enhanced situational awareness in a Military Operations in Urban Terrain MOUT training environment for the Marine Security Forces.
- Continued demonstration and evaluation of technologies available for prototype of RF tracking and video tracking fusion capability for enhanced situational awareness in a MOUT training environment.
- Continued demonstration and evaluation of technologies available for prototype of a Rapid Portable Synthetic Environment Generation capability.

FY 2005 Plans:

- Complete the development of RF tracking and video tracking fusion for enhanced situational awareness in a MOUT training environment.
- Complete demonstration and transition of a prototype of Video Flashlights capability for enhanced situational awareness in a MOUT training environment for the Marine Security Forces.
- Continue development and evaluation of low-cost, dynamic cognitive skills training tools (tactical decision simulations) that cut across every echelon for individual, groups, and groups of groups.
- Continue advanced development and evaluation of technologies capable of Rapid Synthetic Environment Generation within urban MOUT landscapes.
- Continue to demonstrate and measure improvement in situational awareness and a MOUT training environment.
- Initiate integrating cognitive performance improvement (augmented cognition) technology using operationally relevant systems and scenarios, and demonstrate improved human cognition via multiple sensory modalities.
- Initiate the integration and evaluation of cognitive state detection technologies with instructor-based training scenario applications and demonstrate improved individual task performance.

FY 2006 Plans:

- Continue development and evaluation of low-cost, dynamic cognitive skills training tools (tactical decision simulations) that cut across every echelon for individual, groups, and groups of groups.
- Continue advanced development and evaluation of technologies capable of Rapid Synthetic Environment

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Generation within urban MOUT landscapes.
- Continue to demonstrate and measure improvement in situational awareness and a MOUT training environment.
- Continue integrating cognitive performance improvement (augmented cognition) technology using operationally relevant systems and scenarios, and demonstrate improved human cognition via multiple sensory modalities.
- Continue the integration and evaluation of cognitive state detection technologies with instructor-based training scenario applications and demonstrate improved individual and team task performance.
- Initiate the development of tools to capture metrics and lessons learned from a variety of simulation and training sources.

FY 2007 Plans:

- Complete development and transition of low-cost, dynamic cognitive skills training tools (tactical decision simulations) that cut across every echelon for individual, groups, and groups of groups.
- Continue advanced development and demonstration of technologies capable of Rapid Synthetic Environment Generation within urban MOUT landscapes.
- Continue to demonstrate and measure improvement in situational awareness and a MOUT training environment.
- Continue integrating cognitive performance improvement (augmented cognition) technology using operationally relevant systems and scenarios, and demonstrate improved human cognition via multiple sensory modalities.
- Continue the integration and evaluation of cognitive state detection technologies with instructor-based training scenario applications and demonstrate improved individual and team task performance.
- Continue the development of tools to capture metrics and lessons learned from a variety of simulation and training sources.
- Initiate development of scenarios and prototype applications demonstrating improved team performance in stressful urban environments.

	FY 2004	FY 2005	FY 2006	FY 2007
LOGISTICS	2,438	2,660	3,055	3,565

This activity supports Marine Corps Expeditionary Logistics which is the practical discipline and real world application of the deployment, sustainment, reconstitution, and re-deployment of forces engaged in expeditionary operations. Expeditionary Logistics replaces mass with assured knowledge and speed, is equally capable ashore or afloat in austere environments, and is fully scalable to meet uncertain requirements. Expeditionary Logistics logically divides into five pillars: deployment support, force closure, sustainment,

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reconstitution/redeployment, and command and control. These pillars are thoroughly integrated and perpetually related in execution.

FY 2004 Accomplishments:

- Completed initial research into demonstrating the feasibility of a lightweight micro turbine power generation technology.
- Completed initial research into the feasibility of a micro-channel, methanol reforming fuel cell battery charger technology.
- Continued development of hybrid alternative power systems focusing on metal oxide battery technology (zinc air batteries) with ultra-capacitors.
- Continued development of a computer simulation-based tool for evaluating power requirements and powering options for electronic equipment used by Marine Expeditionary Forces.

FY 2005 Plans:

- Complete development of hybrid alternative power systems (metal oxide battery technology) to demonstrate performance improvement.
- Continue development of a computer simulation-based tool for evaluating power requirements and powering options for electronic equipment used by Marine Expeditionary Forces.
- Initiate exploring the development of portable fuel cell technologies capable of providing power in the 100 Watt to 500 Watt power range.
- Initiate next phase of research into developing a lightweight expeditionary bridging capability through assessment of bridge design, manufacturing, construction, and material solutions to include composites, extrusion, and forming techniques.

FY 2006 Plans:

- Complete development of a computer simulation-based tool for evaluating power requirements and powering options for electronic equipment used by Marine Expeditionary Forces.
- Continue developing a lightweight expeditionary bridging capability.
- Continue exploring the development of portable fuel cell technologies to demonstrate performance improvement.

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- Initiate developing and assessing concepts that permit precision delivery of logistics assets while also reducing the logistics footprint ashore.

FY 2007 Plans:

- Continue exploring the development of portable fuel cell technologies to demonstrate performance improvement.
- Continue developing a lightweight expeditionary bridging capability to demonstrate the feasibility of performance improvement.
- Continue assessing concepts that permit precision delivery of logistics assets while also reducing the logistics footprint ashore to demonstrate the feasibility of performance improvement.

	FY 2004	FY 2005	FY 2006	FY 2007
COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, AND INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE (C4ISR)	2,672	2,556	2,618	3,059

This activity integrates and demonstrates enhanced communications and situational awareness in warfighting environments and communication and situational awareness technologies for near term USMC operations.

FY 2004 Accomplishments:

- Completed demonstration of Low-Probability of Intercept/Low-Probability of Detection (LPI/LPD) ultra-wide band radios for reconnaissance and urban communications.
- Continued Command and Control Technology testbed culminating in the migration of functionality in the systems integration environment for user prototyping, and requirements generation on prospective commercial and developmental software products.
- Initiated and completed ground weapons locating radar study to determine the feasibility of modifying advanced ground-based radar functionality through software changes.
- Initiated and completed development of blue-force tracking information management and data interoperability capabilities.

FY 2005 Plans:

- Complete and transition Command and Control Technology testbed culminating in the migration of functionality

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in the systems integration environment for user prototyping, and requirements generation on prospective commercial and developmental software products.
- Initiate development and demonstration of low-cost compact satellite communications on-the-move capability.
- Initiate integration and demonstration of naval tactical warfighting applications and network connectivity.
- Initiate development and demonstration of urban communications capability.

FY 2006 Plans:

- Complete development and demonstration of low-cost compact satellite communications on-the-move capability.
- Complete integration and demonstration of naval tactical warfighting applications and network connectivity.
- Complete development and demonstration of urban communications capability.
- Initiate demonstration of advanced network mobility and network security capabilities
- Initiate and complete demonstration of urban navigation capability.

FY 2007 Plans:

- Complete demonstration of advanced network mobility and network security capabilities.
- Initiate integration and demonstration of broadband, conformal, ultra-high frequency/very high frequency (UHF/VHF) antennas to be completed in FY 2008.
- Initiate development and demonstration of measurement and signature intelligence data management and integration capability to be completed FY 2008.

	FY 2004	FY 2005	FY 2006	FY 2007
FIREPOWER	0	2,298	2,374	3,265

This activity develops technology for application on current and future expeditionary weapons and elements of the kill chain. It includes, but is not limited to, the following technologies: fuze, fire control, launch/propulsion, lethality, and accuracy.

FY 2004 Accomplishments:

- No Firepower Advanced Research was conducted in FY 2004.

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FY 2005 Plans:

- Complete M1A1 Firepower Enhancement Program support from PE 0602131M.
- Initiate and complete long range, non-lethal weapon, and electronic projectile advanced development.
- Initiate variable yield conventional warhead concept development for experiments and tests to prove technological feasibility, assess operability, scalability and demonstrate general military utility and/or cost reduction potential.

FY 2006 Plans:

- Continue variable yield conventional munitions development from FY05.
- Initiate shipboard submunition microelectromechanical system (MEMS) fuze safety and reliability enhancement effort from PE 0602131M. Prototype and demonstrate MEMS safe and arm device subsystems. Explore systems safety, shipboard storage, sensitivity, affordability and munitions effectiveness for expeditionary maneuver warfare and demonstrate general military utility and/or cost reduction potential.
- Initiate Marine Advanced Combat Headborne System Initiative (MACHSI) advanced technology development. The goal is to increase warfighter head and neck protection while enhancing warfighter comfort and minimizing warfighter encumbrance.

FY 2007 Plans:

- Continue all efforts of FY06.

	FY 2004	FY 2005	FY 2006	FY 2007
MINE COUNTERMEASURES (MCM)	5,796	0	0	0

This activity focuses on advanced development and demonstration of MCM technologies enabling MCM capabilities in synchronization and speed of mine detection, organic neutralization, assault breaching, tactical clearance, proofing, marking, and C4ISR operations.

This activity includes efforts for the AMD. AMD will combine multiple sensing technologies to detect explosives in antipersonnel and antitank mines, a key capability due to the worldwide proliferation of low and non-metallic mines. Initial operational capability is scheduled for FY 2008 and full operational capability for FY 2009.

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AMD will apply NQR science to confirm the presence of explosives. NQR science detects the electromagnetic signal emitted by relaxation of nitrogen atom nuclei in explosives, after tipping caused by a near-resonant frequency pulse. NQR science also detects metal objects and voids by sensing discontinuities in the dielectric properties of the medium, after application of an alternating current pulse. Specialized NQR science applications enable discrimination of buried, multi-compound explosives from clutter such as metal fragments, rocks, and voids.

In FY 2005 and beyond, the MCM efforts are reflected under the Maneuver activity.

FY 2004 Accomplishments:

-Initiated NQR technology integration efforts with a Ground Penetrating Radar (GPR) and Electro Magnetic Induction (EMI) system.
-Developed very low power stochastic NQR pulse sequencing techniques for detection of multiple lines of Trinitrotoluene (TNT).
-Explored methods to compensate for the inhomogeneous Radio Frequency (RF) field of surface coils, for optimizing Signal to Noise Ratio (SNR) for varying inspection depths.
-Continued to improve Radio Frequency Interference (RFI) mitigation techniques and hardware, by considering coil designs, alternate RFI reference antenna designs, correlation between channels, and mitigation algorithms.
-Developed advanced NQR techniques for improved TNT detection, to include pulse sequences that are less sensitive to temperature variations, and examine the possibility of increasing TNT SNR by hybrid NQR/Nuclear Magnetic Resonance techniques.
-Reduced acoustic ringing by developing coils with a reduced electric field and composite RF pulses.
-Completed TNT characterization by determining whether observed differences in TNT formulations represent mixtures of pure orthorhombic and monoclinic crystalline forms, or twinning effects of the monoclinic phase.
-Extended characterization to a broader range of TNT sources, and to tetryl.

C. OTHER PROGRAM FUNDING SUMMARY:
ALL: NAVY RELATED RDT&E:
PE 0602131M (Marine Corps Landing Force Technology)
PE 0603612M (USMC Mine Countermeasures Systems Adv Dev)
PE 0603635M Marine Corps Ground Combat/Support Systems

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PE 0206313M (Marine Corps Communications Systems)
PE 0206623M (Marine Corps Ground Combat/Supporting Arms Systems)
PE 0601152N (In-House Laboratory Independent Research)
PE 0601153N (Defense Research Sciences)
PE 0602782N (Mine and Expeditionary Warfare Applied Research)
PE 0603782N (Mine and Expeditionary Warfare Advanced Technology)
PE 0603235N (Common Picture Advanced Technology)
PE 0603236N (Warfighter Sustainment Advanced Technology)
PE 0204163N (Fleet Telecommunications - (Tactical))
PE 0305204N (Tactical Unmanned Air Vehicles JMIP)

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-Adv Dev)
PE 0603772A (Advanced Tactical Computer Science and Sensor Technology)
PE 0604710A (Night Vision Systems - SSD)
PE 0604808A (Landmine Warfare/Barrier SSD)
PE 0602301E (Computing Systems and Communications Technology)
PE 0602702E (Tactical Technology)

D. ACQUISITION STRATEGY:
Not applicable.

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CONGRESSIONAL PLUS-UPS:

C2297	FY 2004	FY 2005
PROJECT ALBERT	4,105	3,368

Under the umbrella of MCWL experimentation efforts, Project Albert provides design and development of new tools to capture emergent behavior in synthetic environments that, over time, will lead to more effective warfighters. The project's vision includes strong interdisciplinary collaborative teams to address previously unanswered questions relevant to success in warfare. 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.

FY 2004 Accomplishments:
- Continued modeling and developing Data Farming techniques to allow decision-makers to deal with asymmetric threats and the uncertainty inherent in conflicts in today's world. Specific areas of application included surf zone/beach obstacle reduction and mine counter measures, human decision-making and Command and Control, and defense against enhanced blast weapons.

FY 2005 Plans:
- Continue modeling and developing Data Farming techniques. Specific areas of application include Maneuver in Urban Operations and UAV for concurrent operations.
- Initiate Convoy Protection, Improvised Explosive Devices, Manpower versus Technical Tradeoff in Combat Support Operations, Search Pattern Effectiveness for UAVs in a Maritime Environment, and Modeling Aspects of Net Centric Operations.

C9154	FY 2004	FY 2005
ADVANCED LIGHT STRIKE VEHICLE (ALSV)	3,394	0

ALSV is an MV-22 (Osprey (medium lift, vertical takeoff and landing (VTOL) tilt-rotor aircraft) ITV prototype development effort being pursued by the MCWL via Congressional enhancements.

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FY 2004 Accomplishments:
- Continued to capitalize upon lessons learned from the ITV and the Reconnaissance Surveillance Targeting Acquisition - Vehicle (RSTA-V) teaming Marine Corps, Navy, and industry subject matter experts (SMEs) to investigate promising technologies leading to an effective, combat suitable, ALSV.
- Continued to harness promising technologies in an effort to balance and mitigate competing performance requirements against vehicle characteristics such as speed, weight, and size versus mobility and payload.
- Used computer-aided design and key technologies such as advanced suspension, hybrid electric drives, and composites, continued efforts to produce a working (ultimately leading to an objective) prototype.
- Program schedule provided for delivery of two prototype vehicles in September 2005.

C9154	FY 2004	FY 2005
MOBILE FIRE SUPPORT SYSTEM 120MM MORTAR “DRAGON FIRE”	2,784	991

* FY 2004 and FY 2005 funding/efforts were augmented by Marine Corps Warfighting Laboratory (MCWL) core funding; discussed in Project C2297 under Fires, Targeting, and Maneuver subsection.

The Mobile Fire Support System (MFSS), now referred to as Dragon Fire II, is an automated and modular rifled 120-millimeter fire support system concept demonstrator that uses automation to improve precision, responsiveness, and digital connectivity to support units. It is capable of firing from its towed carriage and from its modified LAV interchangeably and in its towed configuration is transportable within the MV-22 Osprey aircraft.

FY 2004 Accomplishments: Proceeded with efforts to complete design and fabrication. These included gun assembly and safety release testing/documentation.

FY 2005 Plans: Will complete software and engineering design. The new concept demonstrator system is being fabricated and test firings are being conducted to complete the system.

C9154	FY 2004	FY 2005
RAPID DEPLOYMENT FORTIFICATION WALL (RDFW)	967	990

* FY 2004 funding/efforts were augmented by MCWL core funding; discussed in Project C2297 under Seabasing, Logistics, CSS, and Combat in the Cities subsection.

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RDFW prototyped development/experimentation effort being pursued by MCWL mainly via Congressional enhancements. The purpose of this Improved Expedient Fortification Construction program is to experiment with commercial-off-the-shelf expedient fortification construction systems. By leveraging modern materials and techniques, the Marine Corps can increase force protection while decreasing the manpower hours needed to construct expedient fortifications.

FY 2004 Accomplishments:
- Purchased additional grids and continued investigations and experimentation with new TTPs to improve deployable fortification wall design and construction. These efforts supported the I MEF in OIF.

FY 2005 Plans:
- Conduct extensive ballistic testing using the Air Force's Force Protection Battle Lab.
- Purchase additional grids, in support of the Second Marine Expeditionary Force (II MEF)/OIF deployments, for force protection and road stabilization in theater experimentation in Iraq.

C9154	FY 2004	FY 2005
TELEPRESENT RAPID AIMING PLATFORM (TRAP)	1,700	990

* FY 2004 funding/efforts were augmented by MCWL core funding; discussed in Project C2297 under Fires, Targeting, and Maneuver subsection.

The Remote Precision Gun (also known as TRAP) is a remotely operated weapon system which integrates 5.56 to .50 caliber systems with man-in-the-loop remotely controlled robotic firing and observation systems.

FY 2004 Accomplishments: In support of OIF as well as MCWL sponsored experimentation:
- Initiated slew to cue multi-spectral sensor suites and wireless C2 systems integration.
- Began design overhaul of current system human interface.
- Began upgrade of weapon integration, magazine, and batteries.

FY 2005 Plans:
- Continue the design overhaul and upgrades began in FY 2004.
- Integrate laser range finding module and improved optics with digitally generated aiming crosshair into the system.

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- Conduct operational assessment of the upgraded system with the Second Marine Expeditionary Force (II MEF) in theater. Efforts support OIF.
- Publish report to MCCDC for potential transition to acquisition program of record.

C9154	FY 2004	FY 2005
TRANSPORTABLE TRANSPONDER LANDING SYSTEM (TTLS)	3,398	1,982

TTLS was originally developed under a Defense Advanced Research Projects Agency (DARPA) effort through Naval Air Systems Command (NAVAIR) and Advanced Navigation and Positioning Corporation (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 and Control; and reduced TTLS susceptibility to jamming.

FY 2004 Accomplishments: In concert with MCWL experimentation efforts:
- Continued development efforts in support of the TTLS concept demonstration.
- Provided support for the miniaturization of the prototype version of the landing system.
- Tested the compatibility of the Air Surveillance and Precision Approach Radar and Control System (ASPARCS), the program of record that will integrate elements of the Marine Air Traffic Control and Landing System (MATCALS) to the Operating Forces.

FY 2005 Plans:
- Continue development efforts in support of the TTLS concept demonstration.
- Test a new interrogation method that doubles the current surveillance range while minimizing aircraft transponder occupancy to address the FAA’s concerns.

C9154	FY 2004	FY 2005
USMC UAV/UGV WEARABLE COMPUTER PROJECT	2,466	0

The purpose of this program will be to develop a rugged, user friendly, light-weight, Modular Wearable

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Computer (MOWC) that provides monitoring, command/control, and system status for three separate small unit remote scouting system technologies: UAV, Unmanned Ground Vehicle (UGV) and Unattended Ground Sensor (UGS). The MOWC will bring together real-time reconnaissance, surveillance, and target acquisition data thereby increasing the using unit's overall situational awareness. This coverage, executed by an organic suite of remote sensors, controlled/monitored off of one central MOWC, will provide observational coverage of confined/distant areas where human access is impractical or unsustainable, mitigating risk to the Marines normally carrying out these missions.

FY 2004 Accomplishments:
- Provided for prototype development, software development, testing, and purchase of limited numbers of prototype MOWC computers.
- Integrated three separate small unit remote scouting system technologies.
- Conducted a Limited Technical Evaluation to determine and evaluate future Concepts of Employment, and future technical enhancements of a system at the Marine small unit level.
- The Marine Corps Warfighting Laboratory (MCWL) then experimented and assessed the prototype MOWCs to determine the efficacy of such a computer system at the Marine small unit level.

R2995	FY 2004	FY 2005
C3RP	3,747	4,656

FY 2004 effort 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 (both federal and state), and the private sector, which can evolve into a valuable national resource. FY 2005 Efforts continue to explore this potential and to identify and support relevant research and expertise.

R9290	FY 2004	FY 2005
EXPEDITIONARY WARFARE WATER PURIFICATION	5,405	11,391

FY 2004 effort focused on two areas. The first aspect of this program is to build a high capacity 100,000 – 300,000 gallon per day water purification demonstrator which will be transportable by existing cargo lift aircraft, and which can provide logistics support for a variety of strategic and operational missions including humanitarian operations and disaster relief. The second aspect of this program focuses on

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

stimulating discovery and invention in science and technology to push well beyond the present state of the art in water reclamation, purification, energy, and distribution technologies. This aspect of the program seeks to identify, develop and transition alternative water purification technologies which will significantly improve mid-term (5-10 years) and longer (10-20 year) technological capabilities.

FY 2005 effort will conduct comprehensive search for robust, dynamic, other than classical S&T approaches to water desalination, reclamation, and energetics, distribution, on the national and international scale. Fund select S&T efforts deemed to have higher than average expectation of reducing the cost of water purification in terms of power, footprint, and so on. Utilizing both the Generation I demonstrator, and the Generation II preliminary specification and engineering design, conduct studies and analysis of promising S&T derived from the EUWP S&T program to date. Simultaneously, develop a Generation II, 300 – 500,000 gallon per day (GPD) engineering prototype which can be used to develop knowledge products for military, federal, and applicable commercial entities of successful S&T also emanating from the Expeditionary Warfare Water Purification (EUWP) S&T investment program, as well as newly emerging technology from independent sources. Such a studies and analysis process will be available for use to address such issues as scalability of select “technology insertion” candidates into large capacity water systems both ship board and land based.

R9333	FY 2004	FY 2005
CENTER FOR EXCELLENCE FOR ROBOTICS, ADVANCED TECHNOLOGY DEMO	1,345	0

This effort is related to development and deployment of robotic systems, to include the use of autonomous and semi-autonomous vehicles in military and civil application domains.

R9334	FY 2004	FY 2005
RAPID REPAIR, PORTABLE PRODUCTION (R2P2)	961	0

This effort is to explore new capabilities in basic infrastructure technologies such as construction materials. New lighter materials that are thermally resistant, bio-resistant, and more rapidly deployable are mission critical to Expeditionary Forces. The R2P2 initiative focused on an emerging class of advanced lightweight composite materials (chemically bonded residuals) and their ability to address enhancements in areas such as rapidly formed, lightweight columns for expeditionary force bridges, thermally resistant

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

overlays for takeoff/landing of vertical aircraft, and new runway overlay repair techniques for rapid conversion of bomb damaged enemy airfields.

R9444	FY 2004	FY 2005
ADVANCED MINE DETECTOR SYSTEM	0	2,576

Effort supports Advanced Mine Detector System.

R9444	FY 2004	FY 2005
MAN-PORTABLE QUADRUPOLE RESONANCE LANDMINE DETECTION	3,405	0

This effort focused on advanced development and demonstration of landmine countermeasures technologies; specifically, a landmine detection system on quadrupole resonance technology, engineered into a man-portable configuration.

R9485	FY 2004	FY 2005
CRAFT INTEGRATED ELECTRONIC SUITE (CIES)	0	991

Integrate an electronic control system and add the sensors and C2 systems required to enhance the situational awareness of the crew of a small boat (Stilitto). The objective of the work is to ready the Stilitto for participation in experimentation that is aimed at understanding ad hoc survivable networks. The deliverable is a boat with upgraded electronic control and C4ISR. Technology transfer to the Sea Lion program of record is expected.

R9486	FY 2004	FY 2005
EXCALIBER UNMANNED TACTICAL COMBAT VEHICLE	0	991

Effort supports Excaliber Unmanned Tactical Combat Vehicle.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603640M PROGRAM ELEMENT TITLE: MARINE CORPS ADVANCED TECHNOLOGY DEMONSTRATIONS (ATD)
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9487	FY 2004	FY 2005
PORTABLE METHANOL FUEL CELL	0	991

This effort is designed to develop direct methanol fuel cell electrochemistry by employing advanced micro-fuel cell technology in passive, ambient conditions (e.g. no balance of plant for humidity and no temperature controls). This no fault methanol fuel cell module (cells will be both in parallel and in series) will leverage industrial battery research efforts directed towards the consumer market. The ultimate research goal is to provide a lighter, longer lasting power supply thereby reducing the weight of batteries carried by individual Marines.

R9488	FY 2004	FY 2005
STUDY TO IDENTIFY AND EVALUATE ALTERNATIVE FIXED-WING LIFT PLATFORMS	0	991

Effort supports Study to Identify and Evaluate Alternative Fixed-Wing Lift Platforms.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603651M
PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS PROGRAM
COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
C3022 Joint Non-Lethal Weapons								
C3022	0	5,809	2,394	1,397	10,791	10,807	11,024	11,246

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element (PE) covers the applied research and development of next-generation Non-Lethal Weapons (NLWs) and includes performing analysis, technical development efforts, and modeling and simulation necessary to ensure optimum weaponizing and use of these NLWs. Next-generation NLW systems focus on long-range localized NL effects to identified threat individuals (or groups of individuals) and/or their threat weapons systems operating in complicated environments such as urban areas, crowds, building, vehicles, boats and also in close proximity to high-value civilian establishments. This effort was funded under PE 0603114N, Power Projection Advanced Technology. Because the Marine Corps is the Executive Agent for the Joint Non-Lethal Weapons Program , a distinct program element was established to properly reflect this designation.

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	0	0	0	0
PBD-702 Adjustment	0	5809	2394	1397
FY 2006/2007 President’s Submission	0	5809	2394	1397

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603651M
PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS PROGRAM

ACCOMPLISHMENTS/PLANNED PROGRAM:

FY 2005 Plans:

• Initiate program to conduct feasibility assessments and demonstrations of promising non-lethal technologies and system concepts. Initial efforts will assess the general utility, effect, and effectiveness of technologies for incapacitating personnel, clearing facilities, stopping vehicles and vessels, and denying enemy access to protected areas.
• Explore design and fabrication of a man-transportable laser weapons system that can be used for non-lethal counter-personnel or non-lethal counter-material applications through ultra-high precision engagement of selected targets with minimal collateral damage.

FY 2006 Plans:

• Research to define the optimum approaches, technologies and tactics necessary to clear a facility/building with and without entry. The goal is to develop the next generation clear-a-space device or system that can effectively incapacitate or force evacuation of a facility with minimal collateral effects or injury to occupants and delivered to the target(s) at range.
• Investigate and develop a system or capability suitable for long-range, non-lethal vehicle or vessel stopping with reversible effects, and minimal collateral effects. The technology will be suitable for applications in complex operational environments such as within crowds, within urban environments, within buildings and vehicles, for non-lethal precision strike (extended duration incapacitation/treat neutralization), and for joint force protection applications.

FY 2007 Plans:

• Research the complex relationships between individual, group and crowd dynamics to understanding the macro effects of NLWs. Specifically, investigate factors that cause crowds to move to violent behavior, and what non-lethal technologies will be effective in controlling or mitigating violet crowd behavior. Research to develop advanced non-lethal stimuli models to predict and assess potential injuries based on a broad set of potential new non-lethal stimuli and to also assess the effectiveness of these new non-lethal weapons.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603651M
PROGRAM ELEMENT TITLE: JOINT NON-LETHAL WEAPONS PROGRAM

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
PE 0603851M (Marine Corps Non-Lethal Warfare)

D. ACQUISITION STRATEGY:

Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603706N
PROGRAM ELEMENT TITLE: MEDICAL DEVELOPMENT

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
MEDICAL DEVELOPMENT	26,969	0	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This Program Element is funded in its entirety by Congressional Adds.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603706N
PROGRAM ELEMENT TITLE: MEDICAL DEVELOPMENT

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
Adjustments/Undist. Reductions	-26	0	0	0
Congressional Action	27,686	0	0	0
FY 2004 SBIR	-691	0	0	0
FY 2006/2007 President's Budget Submission	26,969	0	0	0

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603706N
PROGRAM ELEMENT TITLE: MEDICAL DEVELOPMENT

CONGRESSIONAL PLUS-UPS:

	FY 2004	FY 2005
NATIONAL BONE MARROW PROGRAM	26,969	0

FY 2004 Accomplishments: This supported National Bone Marrow Program research efforts including: 1) improving both speed and precision of marrow typing; 2) matching of donors and recipients to support mass casualty contingency situations (from domestic accidents, terrorist incidents or acts of war); 3) developing new methods and generate data needed to accurately and rapidly identify and match HLA (human leukocyte antigen) types of donor and recipient; 4) typing large numbers of individuals from the Department of Defense (DoD) who volunteered to become bone marrow and platelet donors for military casualties or patients requiring bone marrow transplant; 5) providing scientific and technical support and quality control for DNA laboratories in the civilian community; and 6) developing, testing and evaluating military contingency capabilities required to implement the Surgeon General's requirements for improvement of care for casualties of marrow-toxic substances.

C. OTHER PROGRAM FUNDING SUMMARY: Not applicable.

D. ACQUISITION STRATEGY: Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	133,476	167,107	187,943	186,681	174,170	171,789	172,199	175,152
R2497 JOINT EXPERIMENTATION	133,476	165,622	187,943	186,681	174,170	171,789	172,199	175,152
R9489 LOCATION SPECIFIC DIGITAL FINGERPRINTING (LSDF)	0	1,485	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: Combatant Commander (COCOM), U.S. Joint Forces Command (USJFCOM) was chartered "as the Executive Agent for conducting joint warfighting concept development and experimentation within the Department of Defense." The Secretary of Defense signed the USJFCOM's Joint Warfighting Experimentation Charter on 15 May 1998. H8150, 22 September 1998, Sec 922, directed the establishment of Joint Warfighting Experimentation.

Each COCOM has input to the priorities for experimentation through the USJFCOM Combatant Commander Engagement program. The future of joint warfighting is the USJFCOM area of responsibility. Joint Experimentation's purpose is to lay the foundation for national security transformation. Development of a coherent joint force starts with aggressive concept development and robust joint experimentation. USJFCOM establishes a common joint context for the DoD, which has already proven to be a powerful tool that fosters coherence, improved stewardship and early interoperability material solutions "born joint." Concept development, both Joint and Service, happens through intellectual exploration, focus, and partnerships.

DoD priorities supported by Joint Experimentation: a) successfully pursue the Global War on Terrorism; b) strengthen joint warfighting capabilities; c) new concepts of global engagement; d) transform the joint force; e) Homeland Security; f) optimize intelligence capabilities; and g) improve the Department of Defense processes.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION

We ensure this transformation by exploring, testing, and then establishing new combinations of concepts, capabilities, people, and organizations. Through the process of discovering new capabilities, we can exploit our nation's strengths and advantages while protecting ourselves from asymmetric forces that threaten our strategic superiority. Joint Experimentation implements this transformation mission through a process of discovery, innovation, concept development, and experimentation to provide for optimal joint future force capability.

The Joint Experimentation campaign focuses on developing two distinct products as the result of a two-path strategy on which we base our approach to innovation. The first path is called the Joint Prototype Pathway. This conceptual/prototypical system or doctrine evolves from concept experimentation in concert with our partners. These systems are inserted into real world situations (e.g., U.S. Forces Korea) so that we can expand the experimental ground and refine the concept/prototype at the user level to ensure the solutions work as envisioned. This path is designed to help the Department improve near-term warfighting capabilities now by taking new ideas or concepts that originate on the joint concept development pathway and converting them into physical form, as developmental prototypes. From there, these prototypes are put into the hands of joint warfighters as quickly as possible to validate the capability at the user level. While commanders feel that a number of new concepts offer greater promise than current capabilities, they use them with the understanding that they are part of the continuing refinement process. Some aspects of these concepts were utilized in Operation Enduring Freedom and Operation Iraqi Freedom.

The second path is called the Joint Concept Development Pathway. This path and its products consist of actionable recommendations that result from collaborative experimentation with new concepts and capabilities that focus on the next decade. Based on how these concepts perform at the user level, we make recommendations to senior leaders that help them decide how to invest military resources in the next decade. Work performed on the joint concept development path is dedicated to making long-term improvements to military capability, focusing on making next decade improvements to joint warfighting. Part of the campaign strategy is continuous experimentation using Combatant Commanders' exercises and operations (engagement and combat) across a Distributed Continuous Experimentation Environment (DCEE). USJFCOM designed the DCEE to be a world-class resource designed to support continuous experimentation; a sophisticated network of high-tech model and simulations with a global reach, both virtual and physical. This laboratory is capable of conducting various experiments, either locally or globally and, because of this, our partners, the Services, Combatant Commanders (CC)'s, allied nations, or various agencies, may participate in experiments at levels specific to their needs and interests.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION

For joint concept experimentation to be effective, we use four common scenarios that reflect current and future threats based on the geopolitical and military realities we see emerging between now and 2015: 1) major combat operations against an inaccessible adversary who presents a global weapon of mass destruction threat; 2) joint operations in urban environments; 3) operations against a non-state actor with significant regional combat capability, weapons of mass effect, and ties to global terrorist operations; and 4) operations against a faltering or failing state that has regional weapons of mass destruction of mass effect capability. These scenarios are the basis for evaluating the major military challenges that were derived from strategic guidance and input from the Services and CC's. USJFCOM's efforts over the next several years will focus in particular on the following concepts: achieving decision superiority: shared-situation understanding so that we can make decisions and take action faster than any adversary; creating coherent effects: harmonizing military, interagency, and multinational activities at the strategic, operational, and tactical levels against any type of adversary; conducting and supporting distributed operations: planning, preparing, and executing simultaneously in multiple theaters and widely distributed points of action within each theater while denying sanctuaries and protecting ourselves from homeland to point of action.

The Management Initiative Decision (dated 12 Jan 2003) for Advanced Training Technology established the Joint National Training Center (JNTC). The mission is to develop the capabilities that integrate live, virtual and constructive elements into a seamless joint training environment. JNTC creates joint warfighting conditions through a network collection of interoperable training sites and nodes that synthesize personnel, doctrine and technology to achieve combatant commander and service training requirements.

The Secretary of Defense Program Decision Memorandum (dated 12 Dec 2003) tasked USJFCOM with the responsibility for maintaining Joint Simulation System (JSIMS) software and establishing a Software Support Facility (SSF) at the Joint Warfighting Center (JWFC), pending the results of an Analysis of Alternatives (AoA). As a result of the AoA findings, the SSF will further develop additional enhancements to constructive simulations designed to eliminate COCOM training gaps. The center provides the joint training environment with the ability to insert emerging technology or reuse existing systems in the constructive training architecture.

At the July 2004 Australia/US Ministerial Consultations (AUSMIN), the Secretary of Defense (SECDEF) signed an Australian – United States Joint Statement of Principles of Interoperability and affirmed the development of a Joint/Combined Training Center (Capability) (JCTC). The end-state for the JCTC is to enhance high-end training and enable forces to be exercised in Joint/Combined mission essential tasks in order to increase and measure operational capability and preparedness, improve interoperability, facilitate capability development

BUDGET ACTIVITY: 03
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by identifying specific deficiencies that occur in the gaps and seams and develop recommended solutions, and lastly enhance regional security. The JCTC will be linked to DoD's JNTC as part of the Global Joint Training Infrastructure (GJTI) via USPACOM's Gaming and Simulation Facility (GSF) and eventually USPACOM's Pacific Warfighting Center as a cooperative collection of training sites, nodes, simulations, and events.

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

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N
PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	137,315	167,626	173,292	171,693
Cong Rescissions/Adjustments/Undist. Reductions	0	-1,985	0	0
Congressional Action	0	1,500	0	0
Non-Pay Inflation Adjustments	-127	0	0	0
JCTC Program Realignments	0	0	5,000	5,000
Training Capabilities AoA - JNTC	0	0	10,400	10,700
Program Adjustments	0	-34	-770	-729
SBIR Assessment	-3,712	0	0	0
Technical Adjustments	0	0	21	17
FY 2006/2007 President's Budget Submission	133,476	167,107	187,943	186,681

PROGRAM CHANGE SUMMARY EXPLANATION:

Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION
PROJECT NUMBER: R2497 PROJECT TITLE: JOINT EXPERIMENTATION

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R2497 JOINT EXPERIMENTATION	133,476	165,622	187,943	186,681	174,170	171,789	172,199	175,152

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Joint Experimentation Campaign Plan focuses on high priority tasks assigned to U.S. Joint Forces Command (USJFCOM) through the Defense Planning Guidance (DPG) and the Chairman of the Joint Chiefs of Staff (CJCS) Instructions on Joint Concept Development and Experimentation (JCDE). These direct USJFCOM to continue development and refinement of, and experimentation with, Rapid Decisive Operations (RDO) as an integrating concept supported by eight functional concepts that provide critical capabilities for Rapid Decisive Operations. These functional concepts are: Knowledge Centric Command and Control (K/C2) comprised of: Common Relevant Operational Picture (CROP), Adaptive Joint Command and Control (AJC2), and Joint Interactive Planning (JIP); Focused Logistics (FL); Information Operations (IO); Assured Access (AA); Strategic Deployment (SD); Operational Net Assessment (ONA); Joint Intelligence, Surveillance and Reconnaissance (JISR) and Effects-Based Operations (EBO).

In FY 2003, USJFCOM moved to a continuous experimentation environment. USJFCOM accelerated the Impact/Vision Experiments as a continuous experimentation pathway in addition to the Joint Prototype Pathway for Standing Joint Force Headquarters (SJFHQ) enabling concepts. A series of experiments addressed the challenges of Rapid Decisive Operations -- Next Decade, Joint Operations Concept (JOpsC), and subordinate Joint Operating Concepts (JOC) to integrate concepts in FY 2015 and beyond. The Impact/Vision experiments provide the joint context for exploring how well these future concepts work together to transform joint military capabilities at the operational level of war. In the Campaign Plan 2003, the Combatant Commander of USJFCOM directed that concepts relating to Joint Command and Control meet the Chairman’s goal of having a Standing Joint Force Headquarters capability for the Combatant Commanders by 2005. USJFCOM synchronized Joint and Service efforts in a “battle rhythm” that balances concept development with experimentation and smaller events that are more agile and adaptable. USJFCOM continues to strengthen these tools for conducting joint concept development and experimentation, including scalable parallel processing for modeling and simulation, providing highly capable and thinking adversaries through more effective red teaming initiatives, and building stronger links with other U.S. agencies and potential coalition partners.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION
PROJECT NUMBER: R2497 PROJECT TITLE: JOINT EXPERIMENTATION

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
JOINT CONCEPT DEVELOPMENT PATHWAY	43,420	47,019	50,543	50,831

FY 2004 Accomplishments:

- Continued the work initiated in FY 2003 on future concepts in the 2015 timeframe and out. All concept development focused on addressing the 18 issues identified by Regional Combatant Commanders:

Achieving Decision Superiority	**Creating Coherent Effects**	**Conducting & Supporting Distributed Operations**
1. Achieving info superiority (anticipatory understanding)	1. Info operations and info assurance	1. Force projection: Deployment, Employment and Sustainability
2. Decision making in a Collaborative Information Environment	2. Joint maneuver and strike: a. Global b. Operational c. Tactical	2. Force protection and base protection
3. Coalition and interagency info sharing	3. Interagency operations	3. Counter anti-access and area-denial (includes Forcible Entry Operations)
4. Global integration	4. Multinational operations	4. Low density-high demand assets
5. Joint ISR	5. Precise effects	5. Proper decentralization
	6. Urban operations	
	7. Deny sanctuary	
	8. Transition operations	

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION
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- Strengthened joint warfighting capabilities, transformed the joint force and assisted the global war on terrorism with Joint Operations Concepts (JOpsC) and subordinate Joint Operating Concepts (JOC) development with its enabling concepts. Development of the JOpsC and subordinate JOCs were critical to transformation of the Department's Joint Warfighting Capabilities. The Transformation Planning Guidance states the transformation of how we fight "hinges on the development of future joint warfighting concepts" and the ongoing reform in the acquisition process will allocate resources based on these joint operating concepts.
- JOpsC: Described how the Joint Force intends to operate within the next 15 to 20 years. Linked strategic guidance with the conceptual framework to guide future joint operations, Service, combatant command and combat support defense agency concept development and experimentation, and the foundation for the development and acquisition of new capabilities.
- Major Combat Operations (MCO): Communicated a more specific vision of how a Joint Force Commander integrates multiple functional concepts within a coherent warfighting strategy that addresses conflicts ranging between nuclear war and peacekeeping.
- Stability Operations: Addressed activities that precede and follow conflict. This concept directly affected future doctrine development, the aforementioned functional concepts, and supported the further development of recommendations.
- Joint Urban Operations (JUO): Developed operational capabilities for warfighting in urban terrain impacting maneuver, engagement and force protection.
- Strategic Deterrence (SD): Strategy that addressed activities designed to deter aggression or coercion, including counter-proliferation efforts, defense against weapons of mass destruction, overseas presence, peacetime military engagement, and both nuclear and non-nuclear strikes.

FY 2005 Plans:

- JCDE emphasis for FY 2005 is developing solutions for capability gaps, process shortcoming and operational shortfalls. Continue to refine future concepts and push discovered capabilities that make a difference for the Joint Task Force Commanders to the field. Emphasis will be on Joint Operations Concepts; Joint Operating Concepts which includes the family of Major Combat Operations, Stability Operations, Strategic Deterrence and Homeland Security; Joint Forcible Entry Operations, Joint Urban Operations, Joint Force Projection and Sustainment for Full Spectrum Operations. These concepts are focused on: a) Major Combat Operations against an adversary with a global weapons of mass destruction (WMD) threat and robust regional anti-access capability; b) joint operations in an urban environment; c) operations against a non-state factor with significant regional combat capability, access to weapons of mass effect, and ties to global terrorist

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION
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organizations; and d) operations in a faltering or failing state that has regional weapons of mass destruction/effects capability.

FY 2006 Plans:

- Emphasis on key areas identified as capabilities gaps and operational shortfalls. USJFCOM will focus on:
- Joint Information Superiority (JxI): USJFCOM's ability to effectively use information in supporting operations is frequently challenged by existing informational means and approaches to create knowledge across the joint force.
- Global Military Integration Capability (JxG): Current and projected military planning, coordination, and execution methodologies are insufficient to support the global conduct of operations.
- Decision Making: The current military decision making process will not fully support a global operating environment, saturated with vast amounts of data, while confronting an adaptive adversary.
- Joint Basing Alternatives: The USJFCOM does not have adequate force projection and sustainment alternatives when indigenous supporting infrastructures are not available to support operations.
- Other areas in concept development include Major Combat Operations, Stability Operations, Strategic Deterrence, Homeland Security, Joint Forcible Entry Operations, Joint Urban Operations, Joint Force Projection and Sustainment for Full Spectrum Operations.

FY 2007 Plans:

- Continue all efforts of FY 2006 concept development with emphasis on key areas identified as capabilities gaps and operational shortfalls.
- USJFCOM will add focus on Joint Deployment and Sustainment (JxDS). Programmed deployment and sustainment methodologies will not support Joint Force operations as specified in the JOpsC family of concepts.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION
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	FY 2004	FY 2005	FY 2006	FY 2007
JOINT NATIONAL TRAINING CENTER (JNTC) ADVANCED TRAINING TECHNOLOGIES (ATT)	26,150	46,188	47,127	46,037

FY 2004 Accomplishments:

- Continued defining, developing, and modeling the JNTC Operational, System and Technical Architectures for a distributed training capability designed to execute Joint Tactical Task-based joint training events. The architecture development formed the technical framework from which JNTC infrastructure and its interfacing systems were designed/integrated. The Operational Architecture organized and modeled system requirements. The System Architecture translated Logical Nodes and packages of requirements to JNTC Physical Nodes and system Configuration Items (CIs) (i.e. sites, products and applications). The Technical Architecture furnished the standards and technical interfaces for integration of JNTC systems.
- Completed an architecturally based systems engineering process to systematically progress from requirements analysis, through architecture development, system design, capability development and integration, testing, certification and deployment. This function included the definition of required standards and interfaces for operation of JNTC infrastructure/capabilities and the implementation of a Collaborative Information Environment (CIE).
- Completed a prototype CIE designed to support: 1) an Operational Collaborative Environment in which USJFCOM, Combatant Commands, Services, and Components can participate in the development of coordinated training plans, event planning and cooperative execution of the Joint Event Life Cycle; 2) a Technical Collaborative Environment for the concurrent development of JNTC software and hardware; and 3) an Event Execution Collaborative Environment for the conduct of distributed joint training events.
- Completed an operational information management/knowledge management plan that serves the needs of JNTC.
- Completed defining, developing, and establishing a Joint Rapid Distributed Database Development (JRD3) Geospatial Intelligent Development System prototype.
- Initiated defining, developing, and establishing a mission rehearsal visualization tool and concept of operations.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION
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FY 2005 Plans:

- Continue all efforts of FY04 less those noted as completed above.
- Perform research and development within a Live, Virtual and Constructive (LVC) distributed testbed to support the advancement of training technologies in the context of a joint integrated battlespace. The testbed will operate as a Continuous Training Research and Development Environment and provide the foundation to a deployable Mission Rehearsal System. The LVC testbed will support advancement of training technologies, Research and Development (R&D) test events and interoperability certification assessments. The testbed will enable new training CONOPS to drive efficiency into the planning and conduct of complex joint training events. It will also provide capability to identify, evaluate and solve training system shortfalls. This testbed will be established as a laboratory at US Joint Forces Command and will draw on other facilities through distributed communications links.
- Prototype a knowledge management framework that provides access to digital libraries and distributed learning centers in the centers of excellence to support Standing Joint Force Headquarters training and mission rehearsal.
- Develop a real world database and distribution system for geography and forces to facilitate training and mission rehearsal capability.
- Develop OPFOR Threat systems to include Service instrumentation, interoperability standards, weapons models and simulated terrain, and virtual training capabilities.
- Design and develop multi-level security modeling and simulation (M&S) capabilities to integrate Department of Defense training.
- Take CIE to Initial Operating Capability (IOC).
- The increase in budget from FY 2004 is due to a planned ramp up which will enable Training Transformation - JNTC to stand up the Joint Advanced Training Technologies Laboratory, contractor support necessary to operate it, and to conduct higher level research and development of new systems in the out years.

FY 2006 Plans:

- Continue all efforts of FY 2005 except work on CIE which will be at IOC in FY 2005.

FY 2007 Plans:

- Continue all efforts of FY 2006.

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	FY 2004	FY 2005	FY 2006	FY 2007
JOINT EXECUTABLE CONCEPT REFINEMENT	28,853	30,508	32,067	32,300

Previously known as Standing Joint Force Headquarters (SJFHQ) Enabling Concept in the FY 2005 President's Budget. The title was changed to eliminate confusion with work being done by the Joint Battle Center to support the Standing Joint Forces HQ Interoperability Technical Demonstration Center (ITDC).

FY 2004 Accomplishments:

- Enhanced and moved FY 2004 concepts from the Joint Concept Development Pathway theory to initial applications at the Regional Combatant Commanders where refinement work took place in real world operations. In FY 2004 joint executable concepts were inserted into the Regional Combatant Commands (RCCs) to refine them at the user level in real world environments. Joint Experimentation finalized work on the enabling concepts that are tied to the fielding of the Standing Joint Force Headquarters by 2005. These enabling concepts are:
- Collaborative Information Environment: a tool and process that provides common situational awareness, understanding, and collaborative workspace for decision makers and staff without today’s time and space limitations.
- Operational Net Assessment: a product, process, and organization all focused upon understanding the operational environment as well as the effects of friendly actions.
- Effects-based Operations: a method of planning, preparing, and executing operations in which the focus is on achieving common effects on adversaries.
- Joint Interagency Coordination Group: an advisory element on the Commander’s staff that facilitates information sharing and coordinated action across the interagency community.
- Joint Fires Initiative: processes and tools that improve the Joint Force’s capability to apply fires from any force in support of any other.
- Joint Logistics (Common Relevant Operating Picture): a tool that addresses the deployment, employment, and sustainment for a coherently joint and multinational force.

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FY 2005 Plans:

- During 2005 USJFCOM will coordinate the Department's concept development and experimentation efforts. USJFCOM will lead the development, exploration and assessment of new joint concepts, organizational structures and emerging technologies. USJFCOM utilizes a process of discovery, innovation, adaptation and experimentation to drive transformational changes that achieve the optimum future joint force capability.
- USJFCOM will work with national and multinational partners to develop fully integrated, interoperable, and interdependent future military forces that are capable of supporting the Global War on Terrorism and combatant commander's operational needs for continued joint context for all wargames and experiments, coherently joint operational intelligence, integrated command and control acquisition, and multinational and interagency interoperability. This includes moving the Collaborative Information Environment, Operational Net Assessment and Joint Interagency Control Group, Joint Fires Initiative Block 1 and Logistics Common Relevant Operational Picture to Programs of Record for fielding and lifecycle management.
- New efforts for executable concept refinement consist of: Knowledge Advantage, Multinational Information Sharing, Multinational Interagency Group, and Multinational Experiment 4.

FY 2006 Plans:

- Continue concept refinement activities and identify capabilities mature enough for insertion into Combatant Commanders infrastructure to evaluate capabilities in real world operational environments. The USJFCOM goal is to identify maturing applications through experimentation spirals and move them forward into real world situations as to provide an increased capability for joint warfighting.
- Knowledge Advantage: Ability to synthesize information into a construct that provides the joint force commander a strategic and operational edge.
- Multinational and Coalition Information Sharing: Synthesis and multi level stratified information sharing applications through portal technology.
- Multinational Interagency Group: Current methodologies for interagency coordination and information sharing will not support Joint Force operations across the full spectrum of engagement and leveraging to include non governmental and multinational agencies for Diplomatic, Information, Military and Economic (DIME) applications.
- Expand and continue multinational experimentation for multinational and coalition integration and operations coherently across the joint force commander operational needs.
- Multinational Experiment 5: Expand and continue multinational and coalition integration and operations coherently across the joint force commander's operational needs.

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FY 2007 Plans:

- Continue all efforts of FY 2006.

	FY 2004	FY 2005	FY 2006	FY 2007
JOINT SIMULATION SYSTEM (JSIMS)	0	14,099	13,175	11,996

* Funding was realigned from PE 0603757N in FY 2005 and out.

FY 2005 Plans:

- The Joint Warfighting Center(JWFC) based upon findings from the recent Transformation Training - Training Capabilities (TCAoA), will develop additional enhancements to constructive simulations designed to eliminate training gaps identified in the needs analysis. Develop and integrate efforts to close COCOM training gaps in the constructive modeling and simulation environment. The focus of these enhancements is on high priority needs such as: mission rehearsal support by improving rapid database development, replication of non-kinetic processes, building adaptable constructive training systems, enhancing strategic context, support for multi-echelon training, and emerging concepts and missions. This will increase capabilities to support Joint training requirements quickly by providing USJFCOM the ability to insert an emerging technology or reuse existing systems in the constructive training architecture. These enhancements will reduce long-term life cycle costs, increase scalability, composability, and reliability by focusing development efforts. Joint training requirements will drive capabilities development within the joint training federations. The training simulations will include representations and products from the intelligence community that will incorporate intelligence as part of the warfighting/training audience. Funding for the limited simulation enhancement begins to close training gaps in the training environment by eliminating unnecessary redundancy, incorporating automated tools, and increasing commonality in the Joint training simulation toolkit. The JWFC Joint Development and Integration and Software Support Facilities will perform software configuration management (CM) which ensures users are operating the most current versions of simulation software in Joint Exercises. The CM team will document upgrades/fixes to the software and publish 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 insure the Joint training federations operate as delivered, taking steps to correct real-time problems that arise. Specific training (technical and

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operational) will be provided to users prior to conducting a Joint Federation-driven Joint Exercise. Periodic upgrade training will be provided to user sites, and training will be provided for periodic model testing events, as required. The facilities will maintain and control all Joint models and federation 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 2006 Plans:

- Continue all efforts of FY 2005 to develop and enhance capabilities in constructive simulations to support Joint training.

FY 2007 Plans:

- Continue all efforts of FY 2006.

	FY 2004	FY 2005	FY 2006	FY 2007
JOINT DEPLOYMENT, EMPLOYMENT AND SUSTAINMENT (JDES)	7,258	8,056	8,585	8,638

FY 2004 Accomplishments:

- Joint Deployment, Employment, and Sustainment (JDES) focused on near term improvement and next decade capabilities in DES (Logistics and Transportation), to support or solve issues related to Force projection; how we deploy, employ, and sustain the force. JDES directed the development of a collaborative information environment that facilitates the fusion of logistics information and visibility that enhances a Combatant Commander’s ability to deploy and sustain forces.
- Deployed a series of process improvements called “Quick Wins” that enhanced deployment and sustainment processes for joint force commanders and services.

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FY 2005 Plans:

- Continue JDES initiatives focusing on next near term ready applications and next decade capabilities. Joint Force Projection and Sustainment allows the deployment, employment and sustainment of joint forces conducting distributed and non-contiguous operations, in an anti-access or area denial environment.
- Begin design work on a "blank sheet of paper" next generation logistics system. Construct is to work a new process, procedure and system that is not bogged down by the non integrated multiple logistics systems currently in place.
- Develop Force Projection and Sustainment Alternatives: Provide a mix of alternative capabilities to the Joint Force Commanders that increase options for supporting distributed operations under various conditions. Currently the Joint Force Commander does not have adequate force projection and sustainment alternatives when indigenous supporting infrastructures are not available to support operations.
- Develop Joint Basing Alternatives: Provide a mix of alternative solutions to the Joint Force Commanders that increase options for supporting distributed operations under various conditions. Currently the Joint Force Commander does not have adequate force projection and sustainment alternatives in anti-access conditions. Distributed operations requires the capabilities that include extended operational reach, overseas basing, and joint sea basing to provide alternative approaches to force projection and sustainment of the joint force.

FY 2006 Plans:

- Continue efforts to meet Basing Alternatives and Force Projections and Sustainment.
- Provide focused logistics concept development for operating in an adaptive, elastic and ubiquitous distribution-based sustainment system along with the required information architecture to provide and receive time-definite support measured in hours, not days and weeks. Establish a joint sustainment force that is rapidly deployable, fully capable, immediately employable, and responsive to supported forces.
- Joint Deployment Systems Business Process Reengineered Prototype Implementation: Process workflow portal to manage the deployment and sustainment of forces for 1) increased effectiveness to deploy and sustain forces in execution of joint operations; 2) enterprise application integration platform to share data and tools and 3) established functional and technical development "battle rhythm" to delivery rapid operational spirals providing enhanced transformation change solution sets to the warfighter every 9-12 months.
- Joint Deployment Data Transparency: For joint deployment common data model/data standards, and extensible machine language (XML) data schema for shared data and increased system to system interoperability, and provide the strategic framework to plan, influence acquisition, and sustain Joint Deployment Capability for

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the development and management execution of an Integrated Master Plan and Integrated Master Schedule.

FY 2007 Plans:

- Continue all efforts of FY 2006.

	FY 2004	FY 2005	FY 2006	FY 2007
INTEGRATION WITH OTHER REGIONAL COMBATANT COMMANDERS, MILITARY SERVICES AND AGENCIES	6,726	7,466	7,955	8,004

FY 2004 Accomplishments:

- Continued to address Joint Strike, Information Operations and Information Assurance, Global Integration, and Coalition and Interagency Information Sharing. Work continued on expanding Interagency Operations to include other portions of national power. The first wargame included the National Reconnaissance Office which executed the Joint Operations Concept as a backdrop for other joint alternative approaches.

FY 2005 Plans:

- Apply joint context to assist in developing and defining joint operation concepts for use by Joint, Interagency and Multinational warfighting community. Key venues for incorporating these integration activities include Pinnacle Impact, Unified Quest, Unified Course, Thor’s Hammer, Unified Engagement, Joint Urban Warrior, Multinational Experiment 4, and Sea Viking. This approach ensures common, consistent and transparent joint data, tools, services, joint analysis and metrics. Areas under consideration and evaluation include Interagency Incident Management Teams, Global Architecture Intelligence, and incorporation of Department of State support to operations.

FY 2006 Plans:

- Ensure all joint warfighting capability needs of combatant commanders are addressed in experimentation efforts.
- Continue to apply joint context to assist in developing and defining joint operation concepts for use by Joint, Interagency and Multinational warfighting community. Key venues for incorporating these integration

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activities are Pinnacle Impact, Unified Quest, Unified Course, Thor's Hammer, Unified Engagement, Joint Urban Warrior, Multinational Experiment 4, and Sea Viking. This approach ensures common, consistent and transparent joint data, tools, services, joint analysis and metrics. Areas under consideration and evaluation include Interagency Incident Management Teams, Global Architecture Intelligence, and incorporation of Department of State support to operations.

FY 2007 Plans:

Continue all efforts of FY 2006.

	FY 2004	FY 2005	FY 2006	FY 2007
INNOVATION AND EXPLORATION	6,554	7,275	7,751	7,801

FY 2004 Accomplishments:

- Continued using the analytical model to rapidly assess new ideas. Innovation and exploration efforts continued for impacting 2025-2040 timeframe. Investigation continued in areas of Hard-to-Get Signals, sensor development, complexity, crisis and instability forecasting, and others.

FY 2005 Plans:

- Expand efforts to tie Department Joint science and technical efforts to identifY joint warfighting capabilities gaps.
- Continue using the analytical model to rapidly assess new ideas. Innovation and exploration efforts continue for impacting 2025-2040 timeframe. Investigation continues in areas of application of nanobiotechnology, knowledge workers, unmanned effects, multinational information sharing, among others.

FY 2006 Plans:

- Expand efforts to tie Department Joint science and technical efforts to identified joint warfighting capabilities gaps.
- Investigate in areas of application, such as swarming entities, use of compressive receivers in detecting

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and locating "Hard-to-Get" threat emitters, medical operations transformation, and pattern recognition for time-critical targeting, near space applications, special weapons and effects assessment.

FY 2007 Plans:

Continue all efforts of FY 2006.

	FY 2004	FY 2005	FY 2006	FY 2007
MULTI-NATIONAL AND COALITION CONCEPT DEVELOPMENT	4,515	5,011	5,340	5,374

Previously reported under Joint Concept Development Pathway in the FY 2005 President's Budget. Multi-National and Coalition concept development is a high-level interest. For that reason, a new title was developed to report on those high visibility efforts. Funding realigned internally to program to support critical ongoing efforts to integrate operational capabilities with our multinational and coalition partners.

FY 2004 Accomplishments:

- Continued exploring the Multi-National (MN) concept of operations, engagement, education and collaboration with our MN partners. This was through a series of Limited Objective Experiments that explored 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 continued to be embedded in all our other experimentation efforts.

FY 2005 Plans:

- Develop experimental concept integration with operational partners.
- Continue exploring the MN concept of operations, engagement, education and collaboration with our MN partners. USJFCOM continues to increase the visibility of our MN partners needing access to vital information and emphasizing system technology improvements in MLS. USJFCOM will be expanding the current experiment audience beyond the MN Interoperability Council members (Australia, Canada, France, Germany, United Kingdom

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and NATO). Potential additional include Finland, Sweden, Japan and others.

FY 2006 Plans:

- Build upon lessons learned from real world and experimental coalition experimentation. Work on the Content-Bases Information Security and other options to fully engage our partners in the ways and means of joint/coalition warfighting. MN experimentation efforts will include work with other nations to identify and support coalition operations with leading technology or innovations from their national capabilities to export across the coalition collaborative needs.

FY 2007 Plans:

- Continue all efforts of FY 2006.

	FY 2004	FY 2005	FY 2006	FY 2007
Training Capability Analysis of Alternatives Joint National Training Capability (TCAoA/JNTC)	0	0	10,400	10,700

FY 2006 Plans:

- Initiate and conduct a proof of principle test, initially delivers this capability to two COCOMs. This effort will provide organic Observer/Trainers and training support tools to the COCOMs in order to execute their statutory requirements to conduct individual and staff training for assigned forces. Current Joint training is centered on exercises supported by federations of Joint and Services constructive simulations. Additionally, COCOMs require resources to plan, execute, and assess training for the individuals and staffs of Joint Force Commands, Standing Joint Force Headquarters, and Joint Task Forces.
- Initiate and conduct a limited three-year prototype to explore innovative acquisition strategies, which can provide a model for more cost effective acquisition of training tools and contractor support services.

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FY 2007 Plans:

- Continue all efforts of FY 2006.

	FY 2004	FY 2005	FY 2006	FY 2007
STANDING JOINT FORCE HEADQUARTERS (SJFHQ) INTEROPERABILITY TECHNOLOGY DEMONSTRATION CENTER (ITDC)	10,000	0	0	0

Interoperability Technology Demonstration Center (ITDC) funds were realigned to 0604787N PE (BA-4) in FY05 and out.

FY 2004 Accomplishments:

- Interoperability Technology Demonstration Center (ITDC) demonstrated the five categories of operational, system of systems, technical, software, and procedural interoperability of selected new programs or systems prior to further progress within the acquisition system. ITDC initiative supported U.S. Joint Force Command's (USJFCOM) responsibilities for Joint Command & Control (JC2) capabilities. ITDC executed interoperability demonstrations for selected new programs/systems. The purpose of demonstrations were to ensure interoperability within the Joint Command and Control environment (JC2E). The added advantage of the demonstrations was the provision of high quality cost and schedule estimates of low cost support options for a program office. For example, the ITDC, in conjunction with the Deployable Joint Command and Control (DJC2) program office, demonstrated interoperability of prototype capabilities, in support of Standing Joint Force Headquarters (SJFHQ), at lesser cost than contract supported prototype. The ITDC provided interoperability demonstrations leveraging vehicles such as the Joint National Training Capability.

The successful fielding of interoperable JC2 systems is equally dependent on the ITDC as well as the successful completion of the operational assessment process. Both processes support the acquisition process, as it should be implemented in support of SJFHQ standup and other DOD transformation programs. The operational assessment process supports the assessment of operational prototypes in operational environments. These operational prototypes are developed as enablers to approve needs created out of concept experiments and lead to identification for fielding interim capabilities. The ITDC provided interoperability demonstrations of selected (configuration controlled) pilot capability implementations in coordination with a joint program office, such as DJC2. Successful performance of a candidate capability fielded in an interoperability

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demonstration supported the need for capabilities to be "born joint."

	FY 2004	FY 2005	FY 2006	FY 2007
JOINT COMBINED TRAINING CENTER (JCTC)	0	0	5,000	5,000

FY 2006 Plans:

- Program Study and/or a series of Planning and Design studies of desired capabilities as described in JCTC Scoping Study.
- Provide connectivity between USPACOM and Australia JCTC Management Center (ADFWC).
- Prepare ranges as described in JCTC Scoping Study to support Proof of Concept during Talisman Saber 07.
- Lease, borrow, and transport architecture elements of a deployable and/or permanent Live and Constructive environments to support Proof of Concept during Talisman Saber 07.

FY 2007 Plans:

- Lease, borrow, and transport architecture elements of a deployable and/or permanent Live and Constructive environments to support Proof of Concept during Talisman Saber 07.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

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PROGRAM ELEMENT: 0603727N PROGRAM ELEMENT TITLE: JOINT EXPERIMENTATION
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

R9489	FY 2004	FY 2005
LOCATION SPECIFIC DIGITAL FINGERPRINTING (LSDF)	0	1,485

The Location Specific Digital Fingerprint (LSDF) is a digital authentication tool that destroys the capabilities of hacker tools by introducing physics into the computer security equation and offers true security for both wired and wireless networks. In addition to providing unpredictable random numbers that cannot be tracked by hackers, the LSDF also yields specific information about the environment around a computer to allow the identification of the space around it. The LSDF system allows the introduction of the strongest security and access control required by the government for use in National Security Systems and can have significant positive impact in protecting U. S. critical infrastructure. Funding for this effort was not provided through congressional adds in prior years.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N
PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	29,183	66,868	16,068	16,835	19,101	19,492	19,796	20,276
R2334	NATIONAL BONE MARROW PROGRAM							
	0	29,715	0	0	0	0	0	0
R2914	WARFIGHTER PROTECTION ADVANCED TECHNOLOGY							
	12,579	16,548	16,068	16,835	19,101	19,492	19,796	20,276
R9030	ORGAN TRANSPLANT TECHNOLOGY							
	2,437	1,981	0	0	0	0	0	0
R9031	DAMAGE CONTROL OPERATIONS CONCEPTS (DCOC)							
	1,640	0	0	0	0	0	0	0
R9130	NURSING TELEHEALTH RESEARCH							
	0	2,576	0	0	0	0	0	0
R9162	NAVY MEDICAL SYSTEM CONFIGURATION AND TEST BED (NMSCTB)							
	8,201	5,052	0	0	0	0	0	0
R9163	PORTABLE DEVICE FOR REMOTE PRODUCTION OF IV FLUIDS AND PATIENT SPECIFIC IV THERAPIES							
	2,884	0	0	0	0	0	0	0
R9335	CENTER FOR COLLABORATION IN MEDICAL MODELING AND SIMULATION							
	1,442	0	0	0	0	0	0	0
R9490	ANTI-OXIDANT MICRONUTRIENTS PROGRAM							
	0	595	0	0	0	0	0	0
R9491	BATTLEFIELD PHARMACEUTICAL TEST							
	0	991	0	0	0	0	0	0
R9492	BLOOD AND FLUID INFUSION/TRANSFUSION TECHNOLOGY							
	0	1,485	0	0	0	0	0	0

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N
PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

R9493	HEMOSTATIC RESEARCH						
	0	991	0	0	0	0	0	0
R9494	IMPLANTABLE MIDDLE-EAR HEARING SYSTEM						
	0	1,485	0	0	0	0	0	0
R9495	INDIVIDUAL WATER PURIFICATION (IWP) PROGRAM						
	0	2,972	0	0	0	0	0	0
R9496	TISSUE AND LIMB TRANSPLANTATION MEDICAL TECHNOLOGY DEVELOPMENT						
	0	2,477	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program supports the development and demonstration of field medical equipment, diagnostic capabilities and treatments; technologies to improve warfighter safety and to enhance personnel performance under adverse conditions; and systems to prevent occupational injury and disease in hazardous, deployment environments. Navy investment in these areas is essential because Navy/USMC mission needs are not adequately addressed by the civilian sector or other Federal agencies. For example, civilian emergency medicine does not address casualty stabilization during long transit times to definitive care, or the logistics of providing self/buddy-carried, life saving technologies for massive battlefield wounds. The National Institutes of Health (NIH) focuses on disease processes, not product demonstration. Programs are complementary with those of the Army and are coordinated through the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee to prevent duplication of effort.

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

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N
PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	28,318	16,719	18,637	19,812
Cong Rescissions/Adjustments/Undist. Reductions	0	-638	0	0
Congressional Action	0	50,800	0	0
Execution Adjustments	1,541	0	0	0
Non-Pay Inflation Adjustments	-16	0	8	11
Program Adjustments	0	-13	-2,603	-3,060
Rate Adjustments	0	0	26	72
SBIR Assessment	-660	0	0	0
FY 2006/2007 President's Budget Submission	29,183	66,868	16,068	16,835

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2914 PROJECT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R2914 WARFIGHTER PROTECTION ADVANCED TECHNOLOGY	12,579	16,548	16,068	16,835	19,101	19,492	19,796	20,276

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program supports the development and demonstration of field medical equipment, diagnostic capabilities and treatments; technologies to improve warfighter safety and to enhance personnel performance under adverse conditions; and systems to prevent occupational injury and disease in hazardous, deployment environments. Navy investment in these areas is essential because Navy/USMC mission needs are not adequately addressed by the civilian sector or other Federal agencies. For example, civilian emergency medicine does not address casualty stabilization during long transit times to definitive care, or the logistics of providing self/buddy-carried, life saving technologies for massive battlefield wounds. The National Institutes of Health (NIH) focuses on disease processes, not product demonstration. The Army fights linearly, with echeloned health support in trace, and has dedicated medevac platforms. Naval forces fight up to 200 nautical miles from their support bases and evacuate casualties using multi-role platforms (not pre-configured or supplied for medical use). Programs are complementary with those of the Army and are coordinated through the Armed Services Biomedical Research Evaluation Management (ASBREM) Committee to prevent duplication of effort. This project funds the Force Health Protection Future Capability (FHPFC) Program (formerly titled Warfighter Protection Future Naval Capability) and supports the "Sea Warrior" component of the Naval Transformation Roadmap, medical logistics aspects of "Sea Basing" and expeditionary force medical support associated with "Sea Strike".

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
CASUALTY CARE AND MANAGEMENT	5,423	7,446	7,811	8,213

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. FY2004 to FY2005 increase due to initiation of new efforts and continuation/expansion of ongoing efforts.

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PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2914 PROJECT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

FY 2004 Accomplishments:

- Continued development of drugs and devices for treatment of uncontrolled hemorrhage in the far forward battlefield. Blood loss is the leading cause of preventable death in combat.
- Continued development of resuscitation fluids that enhance cardiovascular function, tissue perfusion and oxygen delivery. Improved resuscitation fluids are needed to prevent casualty deaths from shock and associated tissue/organ damage.
- Continued development of medical devices to monitor patient status and identify casualties in danger of progressing into hemorrhagic shock. This will improve triage decisions and allocation of medical evacuation resources.
- Continued identification of Food and Drug Administration (FDA) approved or novel therapeutics that protect against the induction of hemorrhagic shock. A reduced need for resuscitative fluids would significantly reduce the medical logistical burden for Naval forces.
- Continued development of casualty management tools and data. These tools and data are required by combat, material development, and medical planners to evaluate the effectiveness of personal protection systems and healthcare support services, and to project future material and training requirements.
- Initiated development of an effective analgesic for controlling severe pain that does not have the adverse effects of morphine (cardiorespiratory depression, sedation) or the addiction potential. Naval casualties are expected to “stay in the fight” as long as possible and the use of morphine removes that capability.

FY 2005 Plans:

- Continue all efforts of FY2004 less those noted as completed above.
- Initiate development of therapeutic interventions in wound management. Focus is to reduce morbidity resulting in a quicker return to duty and to reduce requirement for medical resources.

FY 2006 Plans:

- Continue all efforts of FY2005 less those noted as completed above.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2914 PROJECT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

FY 2007 Plans:

- Continue all efforts of FY2006 less those noted as completed above.

	FY 2004	FY 2005	FY 2006	FY 2007
CASUALTY PREVENTION	6,149	7,778	7,082	7,071

Casualty Prevention includes enhancing warfighter situation awareness and countering threats from disease, battle and non-battle injuries.
FY2004 to FY2005 increase due to initiation of new efforts and continuation/expansion of ongoing efforts.

FY 2004 Accomplishments:

- Continued development of the capability to provide protection of aircrews from laser attacks. No laser protection capability exists for daytime/nighttime protection of aircrew from tunable frequency lasers.
- Continued development of protective personal gear and physiologic monitoring ensembles to reduce injury risk and enhance personnel safety in operational settings that include: shipboard firefighting and damage control operations, warm and cold water operations for Navy divers, and extreme aircraft operations (g-force, altitude and heat protection).
- Continued effort to develop noninvasive diagnostic tests for diseases. Goal is to create noninvasive tests that produce results in minutes, not hours or days.
- Continued development of improved hearing protection systems, compounds, and techniques for personnel supporting aircraft operations. Completed animal research on cochlear microdialysis for treatment of hearing loss. This effort was previously accounted for in the Healthy and Fit Force activity.
- Completed development of standards for personal armor systems for blunt trauma (BABT).
- Completed laser event detector effort.
- Initiated development of tools to predict injury related to thermobaric and conventional blast. Understanding the mechanisms involved with organ and neurological damage due to blast is crucial to developing effective protective equipment.

FY 2005 Plans:

- Continue all efforts of FY2004 less those noted as completed above.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2914 PROJECT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

- Initiate research into understanding neurological and cognitive effects of blast injuries. There is an increasing amount of information related to the correlation of closed-head blast injury with cognitive and motor deficits as well as long term emotional problems such as Post-Traumatic Stress Disorder (PTSD).
- Initiate development of decision support tools for controlling disease and non-battle injuries on Navy vessels. Current tools are not targeted at the General Medical Officer and do not focus on human behavioral models.

FY 2006 Plans:

- Continue all efforts of FY2005 less those noted as completed above.
- Complete development of tools to predict injury related to thermobaric and conventional blast.

FY 2007 Plans:

- Continue all efforts of FY2006 less those noted as completed above.

	FY 2004	FY 2005	FY 2006	FY 2007
HEALTHY AND FIT FORCE	1,007	1,324	1,175	1,551

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.
FY2004 to FY2005 increase due to initiation of new efforts and continuation/expansion of ongoing efforts.

FY 2004 Accomplishments:

- Continued identification of factors and causes of injury in shipboard and aviation scenarios, and development of exposure guidelines and engineering specifications for preventing mechanical shock-related injury. Muskuloskeletal injury has a major impact on force readiness and warfighter health. Completed initial estimates of factors and solutions for mitigating shock-related injury in Mark V boats.
Note – Previous effort “Continue development of improved hearing protection systems, compounds, and techniques for personnel supporting aircraft operations” is now accounted for in the Casualty Prevention activity.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: R2914 PROJECT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

FY 2005 Plans:

- Continue all efforts of FY2004 less those noted as completed above.
- Initiate development of treatments for warfighter mental health injury. Combat related psychological trauma has been shown to be a major detriment to retention and force readiness.

FY 2006 Plans:

- Continue all efforts of FY2005 less those noted as completed above.

FY 2007 Plans:

- Continue all efforts of FY2006 less those noted as completed above.

C. OTHER PROGRAM FUNDING SUMMARY:

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/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.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

R2334	FY 2004	FY 2005
NATIONAL BONE MARROW PROGRAM	0	29,715

Effort supports the National Marrow Program/Registry, funding research associated with transplantation.

R9030	FY 2004	FY 2005
ORGAN TRANSPLANT TECHNOLOGY	2,437	1,981

Performed trials of newly developed immune therapies designed to achieve tolerance to transplanted tissues without the need for continuous immunosuppression. FY05 will continue advanced animal studies to meet necessary requirements in preparation for clinical trials.

R9031	FY 2004	FY 2005
DAMAGE CONTROL OPERATIONS CONCEPTS (DCOC)	1,640	0

Effort developed and demonstrated a brass board prototype of the Prognostics Framework (PF) approach to supplement, enhance and improve the Automated Hull Damage and Stability Monitoring System (AHDSMS). The enhanced AHDSMS provides visibility of real-time assessment of ship hull damage and compartment flooding which allows for optimization and prioritization of flooding control and stability response strategies.

R9162	FY 2004	FY 2005
NAVY MEDICAL SYSTEM CONFIGURATION AND TEST BED (NMSCTB)	5,751	5,052

Effort established a capability for expediting the delivery of emerging technologies from Navy Medical (R&D) efforts to DoD healthcare. Force health protection technologies developed by the Naval Health Research Center (NHRC) are undergoing further development and systems integration prior to actual field-testing. FY05 effort involves integration into NHRC Integrated Suite of Technologies, development of the capability to import data from other models, and model validation in exercises.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9162	FY 2004	FY 2005
NURSING TELEHEALTH RESEARCH PROGRAM	2,450	2,576

Effort established an international 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. FY05 efforts will establish a beta test of the Virtual Clinical Practicum between Walter Reed Army Medical Center and Mount Aloysius College, implement and evaluate a “Smart Classroom” initiative, and conduct a telehealth-based research study for high cost diabetic patients.

R9163	FY 2004	FY 2005
PORTABLE DEVICE FOR REMOTE PRODUCTION OF IV FLUIDS AND PATIENT SPECIFIC IV THERAPIES	2,884	0

Effort focused on advanced testing of a lightweight, man-portable, disposable device for producing water suitable for injection from potable water in the field.

R9335	FY 2004	FY 2005
CENTER FOR COLLABORATION IN MEDICAL MODELING AND SIMULATION	1,442	0

Effort focused on establishing a National Center for Medical Modeling and Simulation to integrate military, government, and industrial modeling and simulation technologies for use in medical and surgical training and in the delivery of medical services. Efforts included: integrating simulations into medical and surgical training; developing medical preparedness and response simulations; developing methods for on-site and distributed continuing education for medical and health professionals; determining paths for more rapid transition of medical modeling and simulation research into commercial products and programs; developing pro-operative and operative assistance for surgeons performing tissue and organ reconstruction; and facilitating civilian and military cooperation in the application of medical simulations to improve both routine and emergency response capabilities.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9490	FY 2004	FY 2005
ANTI-OXIDANT MICRONUTRIENTS PROGRAM	0	595

Effort evaluates protective effects of a series of antioxidant micronutrient against the adverse effects of blast injuries, ionizing radiation, and hyperbaric oxygen exposures.

R9491	FY 2004	FY 2005
BATTLEFIELD PHARMACEUTICAL TEST	0	991

Effort supports continued development of a pharmaceutical to be used for the resuscitation of combat casualties.

R9492	FY 2004	FY 2005
BLOOD AND FLUID INFUSION/TRANSFUSION TECHNOLOGY	0	1,485

Effort supports blood and fluid infusion/transfusion technology.

R9493	FY 2004	FY 2005
HEMOSTATIC RESEARCH	0	991

Effort develops a hemostatic agent to rapidly control moderate to severe hemorrhage thereby preventing excessive blood loss in combat casualties. The Navy and Marine Corps will benefit from an inexpensive, easy to use, agent to prevent excessive blood loss in combat casualties.

R9494	FY 2004	FY 2005
IMPLANTABLE MIDDLE-EAR HEARING SYSTEM	0	1,485

Effort develops a fully-implantable middle-ear transducer technology for use in treatment of noise-induced hearing loss (NIHL).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603729N PROGRAM ELEMENT TITLE: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9495	FY 2004	FY 2005
INDIVIDUAL WATER PURIFICATION (IWP) PROGRAM	0	2,972

Effort delivers a device that will produce Ringer’s lactate resuscitation fluid for injection utilizing any water source (pond, puddle, well, etc).

R9496	FY 2004	FY 2005
TISSUE AND LIMB TRANSPLANTATION MEDICAL TECHNOLOGY DEVELOPMENT	0	2,477

Effort supports tissue and limb transplantation medical technology development.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N
PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	52,895	33,087	27,603	35,520	41,300	37,782	50,039	47,345
R2916 UNDERSEA WARFARE ADVANCED TECHNOLOGY	44,336	26,251	27,603	35,520	41,300	37,782	50,039	47,345
R9336 HAWAII UNDERSEA VEHICLE TEST AND TRAINING ENVIRONMENT	2,021	2,576	0	0	0	0	0	0
R9337 PRIMAMETRIC MODIFICATION OF THE SQS-53C SURFACE SHIP SONAR	3,363	0	0	0	0	0	0	0
R9338 SAUVIM	1,252	1,288	0	0	0	0	0	0
R9339 SEA TEST FOR TOWED ACOUSTIC ARRAYS	1,923	1,981	0	0	0	0	0	0
R9497 LITTORAL AWS MISSION FOR RIGID HULL-INFLATABLE BOAT (RHIB)	0	991	0	0	0	0	0	0

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

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

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N
PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	46,544	26,515	27,262	32,562
Cong Rescissions/Adjustments/Undist. Reductions	0	-322	0	0
Congressional Action	0	6,900	0	0
Execution Adjustments	7,368	0	0	0
FNC Realignment	0	0	-200	-142
Non-Pay Inflation Adjustments	-43	0	0	0
Program Adjustments	0	-6	-26	-30
Program Realignment	0	0	565	2,962
Rate Adjustments	0	0	2	168
SBIR Assessment	-974	0	0	0
FY 2006/2007 President's Budget Submission	52,895	33,087	27,603	35,520

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

In FY 2004 Project Morgan funding for FY 2005-07 was transferred from PE 0603747N (BA 3) to 0603734N (BA 4). This funding transfer creates a downward funding profile in PE 0603747N.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R2916 UNDERSEA WARFARE ADVANCED TECHNOLOGY	44,336	26,251	27,603	35,520	41,300	37,782	50,039	47,345

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

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
WIDE AREA ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE	23,927	7,352	12,769	15,710

Wide Area ASW Surveillance is focused on dramatically improving the capability to sanitize large areas relative to the capabilities of legacy ASW sensors. Efforts include the development of affordable off-board systems with associated processing and robust, high-bandwidth communications links. The cornerstone of Wide Area ASW Surveillance is the ability to rapidly distribute sensors from air, surface and sub-surface platforms as well as to develop long-endurance sensors and unmanned ASW vehicles. This activity represents a shift from traditional fixed surveillance systems to autonomous, networked, multi-static operation, supported by passive/active signal processing with the objective of increased detection capabilities. This activity includes support to Project Morgan the details of which are classified. Project Morgan funding transferred to PE 0603734N, Project Z1804 in FY 2005 through FY 2007.

As described under the Cooperative ASW Activity, beginning in FY 2005 testing and demonstrations associated

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

with Littoral Warfare Advanced Development will be reported as part of the overall technologies being tested/demonstrated in this PE. As a result, funding no longer is reported under Cooperative ASW, rather it is included in the other activities. This change causes an additional shift among the R-2 Activities.

FY 2004 Accomplishments:

- Completed requirements and technology study for a small, lightweight, low frequency multistatic source.
- Completed development of multistatic sonar signal classification algorithms for incoherent sources and transition to the Naval Air Systems Command Improved Extended Echo Ranging Program in P.E. 0604261N.
- Completed Deployable Autonomous Distributed System (DADS) baseline algorithm development and validation.
- Completed at-sea testing of a DADS five-node design.
- Completed the Claymore Marine (CM) Engineering Development Model (EDM) assessment.
- Completed construction of Advanced Development Model (ADM) of Compact Deployable Multistatic Receiver (CDMR) for use in future at-sea demonstrations.
- Completed an excursion analysis (Decibel Audit) of various possible, technically feasible CM configurations falling outside the scope of the CM EDM assessment.
- Completed documentation of all CM tasks and provided a final report.
- Continued development of multistatic sonar signal classification algorithms for coherent sources.
- Continued development and testing of DADS technologies in preparation for FY 2005 DADS barrier demonstration.
- Continued concept of operations development and performance requirements for multistatic sonar employing remotely operated sound sources and receivers.
- Continued construction of ADM of the Compact Deployable Multistatic Source (CDMS) for use in future at-sea demonstrations.
- Initiated at-sea demonstrations and data collections with the CDMR ADM.
- Initiated test planning for FY 2005 DADS barrier demonstration.

FY 2005 Plans:

- Continue all FY 2004 efforts less those noted as completed above.
- Complete development and testing of DADS technologies in preparation for a barrier demonstration.
- Complete planning for and conduct of DADS barrier demonstration.
- Initiate the writing of DADS system documentation.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

FY 2006 Plans:

- Continue all FY 2005 efforts less those noted as completed above.
- Complete development of multistatic sonar signal classification algorithms for coherent sources.
- Complete concept of operations development and performance requirements for multistatic sonar employing remotely operated sound sources and receivers.
- Complete writing of the DADS system documentation.
- Complete construction of ADM of the CDMS.

FY 2007 Plans:

- Continue all FY 2006 efforts less those noted as completed above.
- Complete integrated at-sea testing of the multistatic system components (CDMR, CDMS, signal processing software, and "field-level" processing).
- Complete DADS deployment study to investigate various tactical deployment options. This effort transitioned from PE 0602747N.
- Initiate DADS deployment feasibility effort.
- Initiate testing of the PALANTIR (A non-acoustic surveillance system) sensor system.
- Initiate tactical test planning for the PALANTIR sensor.

	FY 2004	FY 2005	FY 2006	FY 2007
BATTLEGROUP ANTI-SUBMARINE WARFARE (ASW) DEFENSE	11,636	8,136	14,834	16,268

Battlegroup ASW Defense technology focuses on the development of platform-based sources and receivers aimed at denying submarines the ability to target grey ships. This technology area is primarily concerned with detections inside 10 nautical miles. Battlegroup ASW Defense integrates next-generation technologies, automatic target recognition, sensors that adjust to complex acoustic environments, and environmentally adaptive processing techniques. Battlegroup ASW Defense will enable smaller, lighter, and cheaper arrays, large multi-line arrays, and submarine flank arrays all with environmental adaptation capabilities. This activity includes support to Project Morgan, the details of which are classified. Project Morgan funding transferred to PE 0603734N, Project Z1804 in FY 2005 through FY 2007.

As described under the Cooperative ASW Activity, beginning in FY 2005 testing and demonstrations associated with Littoral Warfare Advanced Development will be reported as part of the overall technologies being

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

tested/demonstrated in this PE. As a result, funding no longer is reported under Cooperative ASW, rather it is included in the other activities. This change causes an additional shift among the R-2 Activities.

FY 2004 Accomplishments:

- Completed the establishment of a Counter Torpedo Detection, Classification, and Localization (CTDCL) processing baseline.
- Continued development, demonstration and transition of Sonar Automation Technology (SAT) threat submarine detection and classification algorithms to Naval Sea Systems Command (NAVSEA) under PE 0603561N (Advanced Submarine System Development), Project S0223 (Submarine Combat Systems Improvements).
- Continued hardware component integration, testing and installation of an acoustic array test bed in support of future passive sonar system designs. Applied research related to future passive sonar system designs were carried out in PE 0602747N.
- Continued adaptive beamforming technology development. Applied research relative to future passive sonar system designs were carried out in PE 0602747N.
- Initiated a performance evaluation of a CTDCL prototype torpedo protection system capable of countering two torpedoes launched in rapid succession.

FY 2005 Plans:

- Continue all FY 2004 efforts less those noted as completed above.
- Continue development, demonstration and transition of Sonar Automation Technology (SAT) threat submarine detection and classification algorithms to Naval Sea Systems Command. A similar algorithm effort reported prior to FY 2005 in PE 0602747N was merged with this effort.
- Initiate integration of CTDCL processing with advanced sensors for outyear transition to the AN/WSQ-11 program via the Block II and III upgrades.
- Initiate Multi-Mode Magnetic Detection System (MMMDS) development of magnetometer sensor technologies and deliver the first AN/ASQ-233 magnetometer sensor.
- Initiate the integration of MMMDS sensor hardware/software into towed vehicles and fixed-wing Unmanned Air Vehicles (UAV).

FY 2006 Plans:

- Continue all FY 2005 efforts less those noted as completed above.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

- Complete collection and analysis of MMMDS performance data. This work transitioned from PE 0602747N.
- Complete evaluation of proposed MMMDS processing approaches and down-select to one approach. This work transitioned from PE 0602747N.
- Complete planning for MMMDS tests that utilize fixed wing aircraft, helicopter, and UAV platforms.
- Complete performance evaluation of a CTDCL prototype torpedo protection system capable of countering two torpedoes launched in rapid succession.
- Complete integration of CTDCL processing with advanced sensors.

FY 2007 Plans:

- Continue all FY 2006 efforts less those noted as completed above.
- Complete development, demonstration and transition of SAT threat submarine detection and classification algorithms to the NAVSEA.
- Complete characterization of undersea threat signals and clutter to be used to design new signal processing algorithms for submarine and surveillance sonar systems.
- Complete MMMDS development of magnetometer sensor technologies.
- Complete test flights to collect relevant MMMDS data.
- Complete a performance evaluation of a CTDCL prototype torpedo protection system capable of countering four torpedoes launched in rapid succession.
- Complete signal processing, control algorithm and testbed development; initiate transition of processing and sensor technologies to AN/WSQ-11 Program, PE 0603506N. This CTDCL effort transitioned from PE 0602747N.

	FY 2004	FY 2005	FY 2006	FY 2007
COOPERATIVE ANTI-SUBMARINE WARFARE (ASW)	5,620	3,722	0	0

Cooperative Anti-Submarine Warfare (ASW) technology developments enable ASW platforms to work together effectively to detect, classify and localize very quiet undersea targets. Many of the tools required to achieve this objective have been developed under the heading of Integrated ASW (IASW) in Program Elements (PEs) 0602235N and 0603235N. The IASW effort has since been terminated due to budget reductions. The focus of this project is to demonstrate the operational utility of employing these IASW tools together with ASW sensor technologies developed as part of the Battlegroup ASW Defense, Wide Area ASW Surveillance, and Neutralization program areas. Demonstrations are conducted primarily in conjunction with Fleet platforms and exercises. This activity includes support to Project Morgan the details of which are classified. Project Morgan funding transfers to PE 0603734N, Project Z1804 in FY 2005 through FY 2007.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

As described under the Cooperative ASW Activity, beginning in FY 2005 testing and demonstrations associated with Littoral Warfare Advanced Development will be reported as part of the overall technologies being tested/demonstrated in this PE. As a result, funding no longer is reported under Cooperative ASW, rather it is included in the other activities. This change causes an additional shift among the R-2 Activities.

FY 2004 Accomplishments:

- Continued Littoral Warfare Advanced Development (LWAD) activities for two Littoral Anti-Submarine Warfare (LASW) FNC at-sea experiments off the coast of the continental United States and one overseas.

FY 2005 Plans:

- Testing and demonstrations associated with LWAD activities will be reported in the future as an integral part of the overall technologies being tested/demonstrated in PEs 0602747N and 0603747N.

	FY 2004	FY 2005	FY 2006	FY 2007
NEUTRALIZATION	3,153	7,041	0	3,542

Neutralization focuses on undersea weapons technologies to counter threat submarines by increasing the Probability of Kill (PK). Weapon technology areas include: (1) Non-Traditional Homing which addresses the demonstration of the operational utility of a stealthy torpedo detection, classification and homing sensor. This effort has been terminated in FY 2004 due to budget reductions; (2) Torpedo Bridging Technologies (TBT) which addresses development of technologies to enable a heavyweight torpedo and a shooting platform to be effectively employed as a fully-linked weapon system; and (3) the SwampWorks Advanced Torpedo effort which demonstrates technologies to meet emerging challenges of low Doppler, small targets (diesel submarines), in harsh littoral environments. The ultimate goals of Neutralization are to develop reduced size advanced undersea weapons with revolutionary capabilities and to fill Sea Shield mission capability gaps.

As described under the Cooperative ASW Activity, beginning in FY 2005 testing and demonstrations associated with Littoral Warfare Advanced Development will be reported as part of the overall technologies being tested/demonstrated in this PE. As a result, funding no longer is reported under Cooperative ASW, rather it is included in the other activities. This change causes an additional shift among the R-2 Activities.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

FY 2006 reflects the transfer of funds requirements associated with Swampworks to PE 0603758N. FY 2007 reflects continuation of TBT development efforts funded in FY 2005.

FY 2004 Accomplishments:

- Continued development and demonstration of technologies to enable a torpedo and a shooting platform to be effectively employed as a fully linked weapon system incorporating TBT.
- Continued demonstration of the SwampWorks advanced half-length torpedo vehicle including self noise, stability and control, and a proof-of-concept littoral upgrade to the MK 48 Advanced Capability sonar.
- Continued demonstration of a broadband recording system (SwampWorks).
- Completed the development and integration of the SwampWorks Advanced Torpedo sonar, a broadband sonar for the heavyweight torpedo (MK 48 ADCAP sonar).
- Initiated transition of broadband signal processing algorithms to Naval Sea Systems Command Advanced Systems Technology Office (ASTO) Advanced Processing Build (APB) – Acoustic in Program Element (P.E.) 0603561N.
- Initiated planning and logistics for in-water demonstration of an improved PK for close-in, submarine-on-submarine engagements. (SwampWorks)
- Initiated the development of a sonar for the new lightweight torpedo, MK 54, under the auspices of SwampWorks.

FY 2005 Plans:

- Continue all efforts of FY 2004 less those noted as completed above.
- Complete transition of TBT coherent broadband signal processing algorithms to Naval Sea Systems Command (NAVSEA) in PE 0603561N.
- Complete transition of TBT weapon control tactics to conduct advanced counter-countermeasure algorithms and Area of Uncertainty multi-way-point search to the MK 48 Common Broadband Sonar System via NAVSEA in P.E. 0603561N.
- Complete in-water demonstration of an improved capability for TBT close-in submarine-on-submarine engagements.
- Complete evaluation of PK enhancements provided by a broadband heavyweight torpedo effectively employed from an attack submarine as a fully linked weapon system.
- Complete the development of a sonar for the new lightweight torpedo, MK 54, under the auspices of SwampWorks.
- Complete the final submarine exercise for the SwampWorks broadband sonar associated with the heavyweight

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

advanced capability torpedo (MK 48).

FY 2006 Plans:

- All SwampWorks related activities will transfer to P.E. 0603758N in FY 2006 and out.

FY 2007 Plans:

- Initiate broadband and adjunct sensor data collection for development of lightweight TBT to result in a new dual-mode sensor guidance and control system.

C. OTHER PROGRAM FUNDING SUMMARY:

NAVY RELATED RDT&E:
- P.E. 0204311N (Integrated Surveillance Systems)
- P.E. 0205620N (Surface ASW Combat System Integration)
- P.E. 0601153N (Defense Research Sciences)
- P.E. 0602235N (Common Picture Applied Research)
- P.E. 0602435N (Ocean Warfighting Environment Applied Research)
- P.E. 0602747N (Undersea Warfare Applied Research)
- P.E. 0602782N (Mine and Expeditionary Warfare Applied Research)
- P.E. 0603235N (Common Picture Advanced Technology)
- P.E. 0603254N (ASW Systems Development)
- P.E. 0603506N (Surface Ship Torpedo Defense)
- P.E. 0603513N (Shipboard System Component Development)
- P.E. 0603553N (Surface ASW/1704 ASW Advanced Development)
- P.E. 0603734N (Chalk Coral)
- P.E. 0604221N (P-3 Modernization Program)
- P.E. 0604261N (Acoustic Search Sensors)
- P.E. 0604503N (Submarine Systems Equipment Development)
- P.E. 0604784N (Distributed Surveillance System)

NON-NAVY RELATED RDT&E:
- P.E. 0603175C (Ballistic Missile Defense Technology)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2916 PROJECT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY

P.E. 0602702E (Tactical Technology)
P.E. 0603739E (Advanced Electronics Technology)
P.E. 0603763E (Marine Technology)

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

R9336	FY 2004	FY 2005
HAWAII UNDERSEA VEHICLE TEST AND TRAINING ENVIRONMENT	2,021	2,576

FY 2004: Reviewed and identified opportunities to develop an advanced test and training facility to enhance operational training and translate operational needs into design and improvement requirements.
FY 2005: Develop and test advanced technologies to meet operational requirements related to the Advanced Swimmer Delivery Vehicle.

R9337	FY 2004	FY 2005
PRIMAMETRIC MODIFICATION OF THE SQS-53C SURFACE SHIP SONAR	3,363	0

FY 2004: Developed and demonstrated a modification to the AN/SQS-53C sonar which allows conventional as well as lower frequency operation.

R9338	FY 2004	FY 2005
SAUVIM	1,252	1,288

FY 2004 and FY 2005: Continued development and demonstration of an unmanned, underwater vehicle capable of navigation, station keeping and performing complex tasks using a robotic arm, all with minimal interaction from an operator stationed on the ocean surface. Strong underwater currents and limited visibility exacerbate the problem of vehicle navigation and control. Performing tasks with the arm requires the development of complex robotic control algorithms and the capability to recognize and determine the dimensions of underwater objects.

R9339	FY 2004	FY 2005
SEA TEST FOR TOWED ACOUSTIC ARRAYS	1,923	1,981

FY 2004: Initiated development, design and modeling of a novel sonar waveform and signal processing technique

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603747N PROGRAM ELEMENT TITLE: UNDERSEA WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

for use with the Multi-Function Towed Array for improved detection of submarines.
FY 2005: Expand the current at-sea test to extend the existing array shape prediction capability to include the TB-16 towed array under drastic maneuvering and high speed conditions.

R9497	FY 2004	FY 2005
LITTORAL AWS MISSION FOR RIGID HULL-INFLATABLE BOAT (RHIB)	0	991

FY 2005: Initiate adaptation and testing of a Variable Depth Sonar System Anti-Submarine Warfare mission package for the Rigid Hull-Inflated Boat.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603757N
PROGRAM ELEMENT TITLE: JOINT WARFARE EXPERIMENTS

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	19,440	26	0	0	0	0	0	0
R3010 JFCOM - JOINT SIMULATION SYSTEM	9,353	26	0	0	0	0	0	0
R9340 NATIONAL SECURITY MODELING, SIMULATION & TRAINING	10,087	0	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Secretary of Defense Program Decision Memorandum (dated 12 Dec 2003) tasked U.S. Joint Forces Command (USJFCOM) with the responsibility for maintaining Joint Simulations System (JSIMS) software and establishing a Software Support Facility (SSF) at the Joint Warfighting Center, pending the results of an Analysis of Alternatives (AoA). The mission of this program is to create a SSF to support the delivery and maintenance of Block I of the JSIMS. JSIMS Block I delivers to the Joint Warfighting Center the simulation capability to train Joint Force Commanders, their components, and staffs. JSIMS is the next generation modeling and simulation tool that will be the cornerstone for Training Transformation and will be one of the key tools to the success of the Joint National Training Center (JNTC).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603757N
PROGRAM ELEMENT TITLE: JOINT WARFARE EXPERIMENTS

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	13,684	26	21	17
Congressional Action	10,500	0	0	0
Congressional Rescissions/Adjustments/Undist. Reductions	-235	0	0	0
SBIR Assessment	-506	0	0	0
Technical Adjustments	-4,003	0	-21	-17
FY 2006/2007 President's Budget Submission	19,440	26	0	0

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Requirements and funding were realigned to BA 4 in FY 2005 and out.

Schedule: Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603757N PROGRAM ELEMENT TITLE: JOINT WARFARE EXPERIMENTS
PROJECT NUMBER: R3010 PROJECT TITLE: JFCOM - JOINT SIMULATION SYSTEM

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R3010 JFCOM - JOINT SIMULATION SYSTEM	9,353	26	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The Secretary of Defense Program Decision Memorandum (dated 12 Dec 2003) tasked U.S. Joint Forces Command (USJFCOM) with the responsibility for maintaining Joint Simulations System (JSIMS) software and establishing a Software Support Facility (SSF) at the Joint Warfighting Center, pending the results of an Analysis of Alternatives (AoA). The mission of this program is to create a SSF to support the delivery and maintenance of Block I of the JSIMS. JSIMS Block I delivers to the Joint Warfighting Center the simulation capability to train Joint Force Commanders, their components, and staffs. JSIMS is the next generation modeling and simulation tool that will be the cornerstone for Training Transformation and will be one of the key tools to the success of the Joint National Training Center (JNTC).

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
JOINT SIMULATION SYSTEM	9,353	26	0	0

Efforts include: software configuration management; joint exercise technical support; JSIMS specific training; resource repository maintenance; and software administrative support.

JSIMS funding and requirements were realigned to BA 4 for FY 2005 and out. The remaining balance will be reprogrammed to PE 0603727N during execution.

FY 2004 Accomplishments:

• The JSIMS SSF performed 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

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603757N PROGRAM ELEMENT TITLE: JOINT WARFARE EXPERIMENTS
PROJECT NUMBER: R3010 PROJECT TITLE: JFCOM - JOINT SIMULATION SYSTEM

technical support to Joint Exercise and other training or testing events were provided to include 24/7 help desk support during a given event, and insuring the JSIMS software operated as delivered, taking steps to correct real-time problems that arose. Specific training (technical and operational) was provided to users prior to conducting a JSIMS-driven Joint Exercise. Periodic upgrade training was provided to JSIMS user sites, and training was provided for periodic model testing events, as required. The SSF maintained and controlled all JSIMS software and documentation in a central location (resource repository) and served as an archive for historical documentation. Perfunctory Software administrative support (considered specialized and technical) was provided to the above functions, to include organic security and engineering expertise.

FY 2005 Plans:

JSIMS funding and requirements were realigned to BA 4 for FY 2005 and out.

FY 2006 Plans:

Not applicable.

FY 2007 Plans:

Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
NAVY RELATED RDT&E:
0603727N Joint Experimentation

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603757N PROGRAM ELEMENT TITLE: JOINT WARFARE EXPERIMENTS
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

R9340	FY 2004	FY 2005
NATIONAL SECURITY MODELING, SIMULATION AND TRAINING	10,087	0

The USJFCOM J7 & Joint Warfighting Center partners with USNORTHCOM and the ODU Research Facility/VMASC to develop and demonstrate models of U.S. urban areas, simulations on the employment of weapons of mass destruction in these urban areas, simulations on the capabilities of the Department’s civil support capabilities, interactive capacity for live responses for local, state and national civil authorities and the means to ultimately become part of a larger full-spectrum national security modeling and simulation architecture. A demonstrated, portable, simulation-driven, training, planning, and decision support capability to support events which focus on middle and upper tier federal, state, regional and local emergency management and disaster response control centers, replicates the full interagency and intergovernmental environment, and models scenarios reflective of the major urban contingencies these organizations must face.

Demonstration of portable modeling and simulation capabilities, which could support the inclusion of state, regional and local government command and control and interoperability training in DoD, Joint and Federal Agency events. This capability was demonstrated in the context of the Determined Promise Homeland Security and Defense Exercise Event, in August 2004. This project shall also serve as a prototype for maintaining a sustained capability to achieve the long-range vision.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N
PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	44,690	15,743	49,288	49,366	70,430	70,535	70,648	70,768
R2918	NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS							
	25,794	15,743	49,288	49,366	70,430	70,535	70,648	70,768
R9341	FORCENET LIMITED OBJECTIVE EXPERIMENTS							
	3,267	0	0	0	0	0	0	0
R9342	TRANSFER FROM OPN - MICROSAT							
	15,629	0	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The mission of this program is to distill technologies from a subscale proof-of-principle into a full-scale prototype and provide it to the warfighter to experiment with during Fleet Battle Experiments (FBE), Limited Objective Experiments (LOEs) and Sea Trial Exercises.

The purpose of Sea Trials, and other warfighter experiments such as FBEs and LOEs, is for the warfighter to explore and experiment with new Concepts of Operation (CONOPS) in the most realistic scenario possible. Frequently, a new CONOP is enabled by new technology applications. The investment described herein seeks to develop, demonstrate and deliver to the warfighter for experimentation the new technologies used during Sea Trial exercises, FBEs or LOEs. These technologies are fielded as robust prototypes in order to allow the warfighter to completely assess their capability in enabling the new CONOP being explored. These fieldable prototypes are referred to as Operational Experimentation Articles (OEAs). Inasmuch as these OEAs are for warfighter experimentation, it is unlikely that documented requirements exist in the Acquisition Program of Record (POR). Nonetheless, after the technology capability has been demonstrated, and the new CONOP has been integrated into military doctrine, then the technology can be inserted into the appropriate POR. An example of this is networked Specific Emitter Identification (SEI), for which no requirement existed in the surface platform community when the project started in FY02. After demonstration and experimentation during FBE-K, Sea Trials in Jun 04 and Combined Joint Task Force (CJTFEX) 04-02, the technology transitioned into the

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N
PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

Surface Electronic Warfare Improvement Program (SEWIP). Similarly, the Forcenet project is intended to yield the tangible evidence needed for the Forcenet Resource/Requirements Sponsor (N61) to define requirements for the Knowledge Management part of Forcenet.

In order to identify the technology areas with the highest relevance, ONR works in collaboration with the Commander, Fleet Forces Command (CFFC), Navy Warfare Development Command (NWDC), the numbered fleets and the Resource/Requirements sponsor in Naval Operations because these commands are responsible for generating, experimenting with, and implementing new CONOPS.

Current efforts support future operational concepts such as Forcenet and Organic Mine Countermeasures, and operational gaps that have been identified during Operation Iraqi Freedom (OIF). For Organic Mine Countermeasures the investment is concentrated on autonomous undersea vehicles; and, for Forcenet, the investment is concentrated on the development of Knowledge Management tools. For OIF, the technologies being prototyped and experimented with are sniper detection, wireless/portable/reconfigurable surveillance systems, and optical/infrared sensors to detect rockets.

This project supports the DON Transformation Roadmap and, in particular, the “Sea Trial: Process for Innovation” aspects.

In FY06 this program element (PE) will also invest in SwampWorks and Tech Solutions. The objectives of these projects share many common elements with the Navy Experimentation Program already described. SwampWorks seeks to develop and demonstrate technologies that address emergent and enduring operational problems in an accelerated timeframe. Some of these technologies may end up in the hands of the warfighter for experimentation, or may culminate in a significant exercise that demonstrates capability then transitions into the Acquisition POR. Examples of past successes are the half-length torpedo which led to the development of the SwampWorks Broadband Sonar and is transitioning to the Mk 48 ADCAP Program. Current efforts are the development and demonstration of celestial navigation systems, jet noise mitigation technologies, blast resistant structures, undersea acoustic communications and a high resolution sonar for the new lightweight torpedo, Mk 54. Tech Solutions seeks to collect operational problems from the deckplate sailor via the website and distill scientific efforts into applications that can solve these operational problems, and give them back to the sailor for evaluation and use. Current Tech Solutions projects are a deck scrubber for the Aircraft Carriers, helmet-mounted communications for the Marines, extremity protection (body armor for limbs) for the Marines, and dust abatement to retain visibility during helicopter landings in the desert. For SwampWorks and Tech Solutions, some of these projects are ongoing and were previously described in the PEs

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N
PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

dedicated to the appropriate mission area. Based on a review of the DON S&T program conducted in FY04, a recommendation was made to collect these efforts into one integrated program that is budgeted and funded from one program element. Due to the common goals of “getting applications into the hands of the warfighter” and developing technologies across the operational spectrum, SwampWorks and Tech Solutions will be reflected in this PE starting in FY06.

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

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N
PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	39,490	16,006	37,279	44,257
Cong Rescissions/Adjustments/Undist. Reductions	0	-260	0	0
Execution Adjustments	5,507	0	0	0
Non-Pay Inflation Adjustments	-37	0	0	0
Program Adjustments	0	-3	-47	-40
Program Realignment	0	0	12,054	5,076
Rate Adjustments	0	0	2	73
SBIR Assessment	-270	0	0	0
FY 2006/2007 President's Budget Submission	44,690	15,743	49,288	49,366

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Increase from FY05 to FY06 is due to realigning SwampWorks and Tech Solutions previously funded under other S&T PEs.

Schedule: Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: R2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R2918 NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS	25,794	15,743	49,288	49,366	70,430	70,535	70,648	70,768

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: The mission of this project is to distill technologies from a subscale proof-of-principle into a full-scale prototype and provide it to the warfighter to experiment with during Fleet Battle Experiments (FBE), Limited Objective Experiments (LOEs) and Sea Trial Exercises. In order to maximize the yield of fieldable prototypes that are available for experimentation we use a two-pronged approach: 1) Concept-based: invest in technologies to fulfill future CONOPS being explored by CFFC, NWDC and the numbered fleets and, 2) Technology-based: capitalize on technology breakthroughs to demonstrate and provide as OEAs prototypes that were not previously envisioned by the warfighter but are responsive to an operational need.

In order to identify the technology areas with the highest relevance, ONR works in collaboration with the Commander, Fleet Forces Command (CFFC), Navy Warfare Development Command (NWDC), the numbered fleets and the Resource/Requirements sponsor in Naval Operations because these commands are responsible for generating, experimenting with and implementing new CONOPS. The highest priority CONOPS include Organic Mine Countermeasures and Forcenet, therefore the Concept-based fraction of the portfolio is invested in technologies to support these CONOPS. In the Technology-based fraction of the portfolio ONR has invested in operational gaps identified during OIF and technologies that enable network-centric warfare.

This project supports the DON Transformation Roadmap and, in particular, the “Sea Trial: Process for Innovation” aspects. The project also funds operational analyses in support of select Future Naval Capabilities (FNCs) and discrete technologies being developed under the Navy's S&T portfolio.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: R2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
NAVAL WARFARE EXPERIMENTATION ARTICLES - TECHNOLOGY-BASED	17,838	8,858	12,321	14,143

The objective of this project is to capitalize on recent technology breakthroughs to develop prototypes quickly and provide them to the warfighter for experimentation during Sea Trials or LOEs. Investments under this activity were previously reported under the Naval Warfare Experimentation Articles – Expeditionary Sensing Elements. This new activity breakout provides improved clarification of the overall investment scope.

FY 2004 Accomplishments:

- Developed, integrated and tested gun detection and locator (GDL) technology on 5 High Mobility Multi-purpose Wheeled Vehicles (HMMWV). Four units were delivered to Yuma for testing prior to providing to the 1-Marine Expeditionary Force (1MEF) for experimentation.
- Developed a portable, reconfigurable surveillance system (a modified Advanced Technology Coastal Area Protection System (ATCAPS)) for the Marines to use during an experimentation exercise at 1 MEF. This system is presently installed and operational in Camp Fallujah. A different prototype of the ATCAPS was developed under SwampWorks for the Navy for a port/pier application (see description under SwampWorks).
- Continued the development of an electromagnetic sensor for anti-submarine warfare cueing.

FY 2005 Plans:

- Continue experimentation with the integrated sensor suite installed on the HSV-X2.
- Continue the development of an electromagnetic sensor for anti-submarine warfare cueing.
- Develop and demonstrate an optical sensor for cueing of Katusha rockets (weapon used against the Marines in Iraq).
- Address issues with the GDL so that it is more robust in the operational environment.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: R2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

FY 2006 Plans:

• Complete the demonstration of the electromagnetic sensor; develop and demonstrate other promising technologies.

FY 2007 Plans:

• Identify other promising technology breakthroughs that can be prototyped and delivered to the warfighter for experimentation.

	FY 2004	FY 2005	FY 2006	FY 2007
NAVAL WARFARE EXPERIMENTATION ARTICLES - CONCEPT-BASED FORCENET	2,870	4,426	4,496	5,203

This project seeks to develop Knowledge Management (KM) tools for the numbered fleets to use during experimentation exercises. The KM tools developed here are based on intelligent agents, and the application identified by the warfighter was to use them to streamline the process of obtaining actionable knowledge. Agents operating in a distributed environment can help by autonomously filtering, retrieving, and processing information, and by matching situational context with established knowledge sources, freeing warfighters from laborious, time intensive, and menial information look up, retrieval, and formatting tasks. Investments under this activity were previously reported under the Science and Technology Analysis Assessment. This new activity breakout provides improved clarification of the overall investment scope.

FY 2004 Accomplishments:

• Developed intelligent agents to perform several tasks for the J2 at C2F and C3F. These tasks consisted of tracking high interest vessels, identifying Blue Force Vessel Port/Yard Visits and a chat scraping tool. LOEs were conducted in the operational environment in Jan 2004 and July 2004. After experimentation with the tools at C2F, some of the tools were installed on the USS Mt. Whitney and used during CJTFEX 04-02.

FY 2005 Plans:

• Experiment with the KM tools at C5F and C6F and to develop new agent-based KM tools for different operational areas at C2F and C3F.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: R2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

FY 2006 Plans:

• Continue to develop KM tools that are robust and the warfighter can use during Sea Trial exercises or LOEs.

FY 2007 Plans:

• Explore other operational areas that can be served with KM technologies. This plan will be developed jointly with N61F and CFFC.

	FY 2004	FY 2005	FY 2006	FY 2007
NAVAL WARFARE EXPERIMENTATION ARTICLES - CONCEPT-BASED ORGANIC MINE COUNTERMEASURES	5,086	2,459	2,498	0

The objective of this project is to develop and experiment with unmanned underwater vehicles (UUVs) modularized for mine warfare (MIW) and mine countermeasures (MCM) during fleet exercises and experiments. Targeted ships of opportunity include the High Speed Vessel (HSV-2) SWIFT, the X-Craft and other surface platforms engaged in MCM operations. With the development of the Littoral Combat Ship (LCS), the Navy has included the development of warfare mission module packages to support Fleet operations in MIW, anti-submarine warfare and anti-surface warfare. The HSV provides a means of effecting spiral development of both the LCS platform and the support mission modules. UUV technology developed within the Organic Mine Countermeasures Future Naval Capability (OMCM FNC) program has been designated for inclusion in LCS Flight 0 ships. Included within the objectives of this program is the development of additional capabilities for existing UUV technology, the development of prototypical UUV mission modules for MCM, and the integration of the modularized UUV system into experimentation platforms of opportunity. Investments under this activity were previously reported under the U.S. Marine Corps Experimentation. This new activity breakout provides improved clarification of the overall investment scope.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: R2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

FY 2004 Accomplishments:

• Two types of UUVs were developed and delivered for integration in the mine warfare mission modules. The third and fourth Battlespace Preparation Autonomous Underwater Vehicles (BPAUV) and the first three Small Shallow Water UUV were completed and delivered. The Mine Warfare UUV mission modules, outfitted with mission planning, data processing and maintenance equipment were integrated into the High Speed Vessel (HSV-2) SWIFT early in the FY. Training of the Fleet operators was conducted at the Naval Surface Warfare Center-Panama City for the employment of the BPAUV and the mission modules systems. The mission module configuration and integration on the HSV was showcased in two static events in Norfolk and Alexandria, Virginia in the second quarter of the FY. This project was certified as a Sea Trial Initiative by the Navy Warfare Development Command. At-sea experimentation commenced in May during the NATO Exercise Blue Game conducted in the littoral waters of Norway. Experimentation continued during CJTFEX 04-2 off Camp Lejeune, North Carolina with the UUV mission modules operating from a shore-based pier facility, demonstrating their flexibility and versatility for support of mine warfare operations at sea or ashore. In July the BPAUV mission module participated in the bi-annual Rim of the Pacific (RIMPAC) exercise off the coast of Hawaii. For this experimentation opportunity, the BPAUV mission module was flown via commercial airlift to Hawaii and embarked aboard HSV-2 SWIFT upon its arrival in theater. Quick installation and readying for operational employment in a mine countermeasures mission further demonstrated the versatility of the mission module concept and design.

FY 2005 Plans:

• The UUV mission modules will participate in additional Fleet exercises and Sea Trial experimentation opportunities as they are identified by Fleet schedulers and the NWDC. In addition the mission modules will participate in both HSV and X-craft operations and experiments in which mine warfare and mine countermeasures events take place.
• Delivery, acceptance testing and certification of the second set of REMUS 100 UUVs will take place in the second quarter. Additional Fleet operator training in the use of Small Shallow Water UUVs is scheduled. Lessons learned from FY04 experimentation events will be incorporated into FY05 improvements to the mission modules.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: R2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

FY 2006 Plans:

• The UUV mission module program will continue with experimentation on craft of opportunity, in particular the HSV-2 SWIFT and X-Craft, and will support the Littoral Combat Ship mine warfare mission module development program.

FY 2007 Plans:

• Program ends in FY 2006.

	FY 2004	FY 2005	FY 2006	FY 2007
TECH SOLUTIONS	*	*	9,991	10,007

* Tech Solutions was previously funded under other S&T program elements.

The objective of this program is to provide deckplate sailors with technical solutions to common operational problems. The sailors provide their operational issues to ONR via the web.

FY 2004 Accomplishments:

• Developed software to translate information from Korean and Thai to English. This product was demonstrated in 2 exercises (Cobra Gold and Foal Eagle) in C7F, both highly successful. (This technology reduces the time to translate power point presentations at least by 80 % with >90% accuracy.)
• Developed extremity protection for arms and legs since the current body armor used by the Marines did not provide limb protection.
• Developed and delivered a scheduler to the submarine community. (Previously, preparing and updating the schedule for all submarine assets was a time-intensive, complicated process. This product is a scheduling engine that generates the schedules more efficiently thereby saving time and manpower.)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: R2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

FY 2005 Plans:

- Develop a sensor package for the Swimmer Delivery Vehicle (SDV) used by the Navy SEALS.
- Develop, demonstrate and deliver to the Marines dust abatement technology that can be used to retain visibility during landings in the desert.
- Develop, demonstrate and deliver to the Marines a hand-held bi-directional Arabic to English/English to Arabic voice to voice and text.

FY 2006 Plans:

- Continue to obtain operational problems from the sailors via the web and develop, demonstrate and deliver technical solutions.

FY 2007 Plans:

- Continue to obtain operational problems from the sailors via the web and develop, demonstrate and deliver technical solutions.

	FY 2004	FY 2005	FY 2006	FY 2007
SWAMPWORKS	*	*	19,982	20,013

* SwampWorks was previously funded under other S&T program elements.

SwampWorks seeks to develop and demonstrate technologies that address emergent and enduring operational problems in an accelerated timeframe. Some of these technologies may end up in the hands of the warfighter for experimentation, or may culminate in a significant exercise that demonstrates capability then transitions into the Acquisition program of record. Examples of past successes are the half-length torpedo which led to the development of the SwampWorks Broadband Sonar and is transitioning to the Mk 48 ADCAP program. Current efforts are the development and demonstration of celestial navigation systems, jet noise mitigation technologies, blast resistant structures, undersea acoustic communications and a high resolution sonar for the new lightweight torpedo, Mk 54.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: R2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

FY 2004 Accomplishments:

- Completed the transition of the Electronic Support Measure (ESM) to the Surface Electronic Warfare Improvement Program (SEWIP).
- Completed the testing of Microjets for jet noise mitigation on a full-scale test engine at NAVAIR Lakehurst. Preliminary analysis of the data collected during the test indicates that a noise reduction (at the source) of 6dB was achieved.
- Completed and installed at C5F in Bahrain a wireless, reconfigurable, integrated system of sensors for port surveillance (this system is called Advanced Technology Coastal Area Protection System (ATCAPS)).
- Continued to identify and respond to enduring and emergent operational barriers identified by the naval leadership.
- Initiated the development and demonstration of a celestial navigation device to reduce the dependency of our platforms and weapons on Global Positioning System (GPS).
- Initiated the development and demonstration of autonomous navigation algorithms. These are needed to increase the autonomy of all unmanned platforms.
- Initiated the development of the advanced sonar for the new lightweight torpedo, Mk 54. Complete the final exercise of the SwampWorks Advanced Torpedo Sonar for the heavyweight torpedo, Mk 48 ADCAP.

FY 2005 Plans:

- Continue the development and demonstration of a celestial navigation device to reduce the dependency of our platforms and weapons on Global Positioning System (GPS).
- Continue the development and demonstration of autonomous navigation algorithms. These are needed to increase the autonomy of all unmanned platforms.
- Continue the development of the advanced sonar for the new lightweight torpedo, Mk 54. Complete the final exercise of the SwampWorks Advanced Torpedo Sonar for the heavyweight torpedo, Mk 48 ADCAP.
- Continue to identify and respond to enduring and emergent operational barriers identified by the naval leadership.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: R2918 PROJECT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

FY 2006 Plans:

- Complete the development of the advanced sonar for the Mk54 torpedo and characterize its performance in a submarine exercise.
- Continue to identify enduring and emergent operational barriers identified by the naval leadership and respond with relevant technology developments and demonstrations.

FY 2007 Plans:

- Continue to identify enduring and emergent operational barriers identified by the naval leadership and respond with relevant technology developments and demonstrations.

C. OTHER PROGRAM FUNDING SUMMARY:
Not applicable.

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603758N PROGRAM ELEMENT TITLE: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

R9341	FY 2004	FY 2005
FORCENET LIMITED OBJECTIVE EXPERIMENTS	3,267	0

ForceNet provided the architecture to increase substantially combat capabilities through aligned and integrated systems, functions, and missions. It transformed situational awareness, accelerated speed of decision, and allowed us to greatly distribute combat power. ForceNet harnessed information for knowledge-based combat operations and increased force survivability. It provided real-time enhanced collaborative planning among joint and coalition partners.

R9342	FY 2004	FY 2005
TRANSFER FROM OPN - MICROSAT	15,629	0

This reflected a congressionally directed transfer of Other Procurement, Navy funding from Naval Tactical Command Support Systems and Common Imagery Ground Surface Systems to the Naval Warfighting Experiments and Demonstration program in support of developing OEAs that support the advanced warfighting concepts. This OEA is a space platform which will enable new missions of strategic importance. The OEAs represent prototype technologies that supported the ForceNet concept and were used in support of warfighter demonstrations.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total PE	41,239	35,255	31,897	34,554	53,396	56,317	61,349	78,442
R2720	OCEAN MODELING FOR MINE AND EXPEDITIONARY WARFARE							
	961	0	0	0	0	0	0	0
R2917	MINE & EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY							
	33,870	32,580	31,897	34,554	53,396	56,317	61,349	78,442
R9166	MODELING THE WARRIOR AS A COGNITIVE SYSTEM - PHASE II							
	1,646	1,684	0	0	0	0	0	0
R9343	AUGMENTED REALITY PROGRAM							
	1,203	0	0	0	0	0	0	0
R9344	EXTREME TERRAIN MEDICAL EVACUATION VEHICLE PILOT							
	1,636	0	0	0	0	0	0	0
R9345	HYPERSPECTRAL IMAGER FOR THE COASTAL OCEAN (HICO)							
	1,923	0	0	0	0	0	0	0
R9561	COUNTERMINE LIDAR UAV-BASED SYSTEM (CLUBS)							
	0	991	0	0	0	0	0	0

A. MISSION DESCRIPTION AND BUDGET ITEM JUSTIFICATION: This program element develops and demonstrates prototype Mine Warfare (MIW) system components that support capabilities enabling Naval Expeditionary Forces to influence operations ashore. Third-world nations have the capability to procure, stockpile and rapidly deploy all types of naval mines, including new generation mines having sophisticated performance characteristics, throughout the littoral battlespace. Gulf War operations demonstrated the requirement to quickly counter the mine threat. Advanced technologies are required to rapidly detect and neutralize all mine types, from deep water through the beach. This program supports the advanced development and integration of sensors, processing, warheads and delivery vehicles to demonstrate improved MIW capabilities. It supports the

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N
PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

Organic Mine Countermeasures (OMCM) Future Naval Capabilities. Within the Naval Transformation Roadmap, this investment will achieve one of three key transformational capabilities required by Sea Shield as well technically enable the Ship to Objective Maneuver (STOM) key transformational capability within Sea Strike.

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

PROGRAM CHANGE SUMMARY:

	FY 2004	FY 2005	FY 2006	FY 2007
FY 2005 President's Budget Submission	38,913	32,899	38,880	37,595
Cong Rescissions/Adjustments/Undist. Reductions	0	-337	0	0
Congressional Action	0	2,700	0	0
Execution Adjustments	2,553	0	0	0
FNC Realignment	0	0	441	4,698
Non-Pay Inflation Adjustments	-37	0	0	0
Program Adjustments	0	-7	-7,391	-7,858
Rate Adjustments	0	0	-33	119
SBIR Assessment	-190	0	0	0
FY 2006/2007 President's Budget Submission	41,239	35,255	31,897	34,554

PROGRAM CHANGE SUMMARY EXPLANATION:
Technical: Not applicable.

Schedule: Not applicable.

FY 2006/2007 RDT&E,N BUDGET ITEM JUSTIFICATION SHEET DATE: Feb 2005
Exhibit R-2a

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2917 PROJECT TITLE: MINE & EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

COST: (Dollars in Thousands)

Project Number & Title	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
R2917 MINE & EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY	33,870	32,580	31,897	34,554	53,396	56,317	61,349	78,442

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. Recent real-world operations demonstrated the requirement to counter the projected mine threat. Advanced technologies are required to rapidly detect and neutralize all mine types, from deep water through the beach. This project supports the advanced development and integration of sensors, processing, warheads and delivery vehicles. It supports the Organic Mine Countermeasures (OMCM) Future Naval Capabilities.

B. ACCOMPLISHMENTS/PLANNED PROGRAM:

	FY 2004	FY 2005	FY 2006	FY 2007
MINE/OBSTACLE DETECTION	11,655	15,786	15,648	15,321

This activity focuses on developing and demonstrating technologies that support detection, classification, identification and multi-sensor data fusion of mine and obstacle data to speed tactical timelines and increase operator standoff. Efforts include: remote sensing techniques/procedures to survey threat mining activities and locations (ends FY04); electro-optic (E-O) sensors/systems to enable unmanned airborne vehicle (UAV) rapid minefield reconnaissance and precise mineline location from very shallow water (VSW) through the beach exit zone; sensors/systems to enable cooperating unmanned underwater vehicles (UUVs) to perform wide-area reconnaissance and assault lane reconnaissance/preparation from shallow water through the surf zone (SZ); decision support and visualization software for amphibious planning/operations; and sensor data fusion to enable a theater mine warfare common operating picture and own ship protection. This activity supports the development and transition of technologies for the Organic Mine Countermeasures (OMCM)Future Naval Capabilities (FNC).

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2917 PROJECT TITLE: MINE & EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

Budget for Mine/Obstacle Detection reflects TOG-approved funding for Organic Mine Countermeasures FNC.

FY 2004 Accomplishments:

-Continued development of Rapid Overt Airborne Reconnaissance (ROAR) multispectral laser, 3-D camera for tactical airborne VSW Surf Zone/Beach Zone (SZ/BZ) day/night mine/minefield/obstacle detection.
-Continued demonstration of integrated UUV search, marking, bathymetry mapping, threat objects and gaps and reporting back in test-bed minefields in VSW environments.
-Continued demonstration of capability to enable diver teams using UUVs to efficiently and accurately reacquire previously targeted areas and individual targets.
-Continued integration of dual frequency small Synthetic Aperture Sonar (SAS) into a UUV for reconnaissance.
-Continued development of multi-platform fusion of AV-15 Kingfisher data and those from high-resolution mine hunting systems (e.g. AN/AQS-20) for improved ship mine detection and avoidance.
-Completed and transitioned Remote Sensing Tier II algorithm refinements and enhancements to the Naval Oceanographic Office.
-Completed demonstration of laser diode array illuminator, enabling a night capability for multispectral detection of minefields on the beach.
-Completed initial demonstration of VSW multi-platform, coordinated UUV reconnaissance and reacquisition/identification during a Combined Joint Task Force Exercise (JTFEX 04-02).
–Initiated integration of Laser Scalar Gradiometer (LSG) in UUV for buried mine classification.

FY 2005 Plans:

-Continue demonstration of capability to enable diver teams with UUVs to efficiently and accurately reacquire previously targeted areas and individual targets.
-Continue demonstration of integrated UUV search, marking, bathymetry mapping, threat objects and gaps and report back in test-bed minefields in VSW environments.
-Continue integration of LSG in UUV.
-Continue development of multi-platform fusion of AV-15 Kingfisher data and those from high-resolution mine hunting systems (e.g. AN/AQS-20) for improved mine detection and avoidance.
-Complete integration of dual frequency small SAS into UUV for reconnaissance and initiate field evaluation.
-Complete development of ROAR multispectral laser, 3-D camera for tactical airborne VSW/SZ/BZ day/night mine/minefield/obstacle detection.
-Initiate at-sea testing of ROAR sensor and begin helicopter integration.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2917 PROJECT TITLE: MINE & EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

FY 2006 Plans:

-Continue development of multi-platform fusion of AV-15 Kingfisher data and those from high-resolution mine hunting systems (e.g. AN/AQS-20) for improved mine detection and avoidance.
-Complete at-sea testing of ROAR sensor for tactical airborne VSW/SZ/BZ day/night mine/minefield/obstacle detection and initiate transition to PMS-495.
-Complete integration of LSG into UUV and initiate field evaluation of LSG performance against buried mines.
-Initiate system development for Over-the-Horizon (OTH) deployment of UUV systems by Autonomous Surface Vehicles (ASVs) and large UUVs.
-Initiate development of buried minefield detection capability for tactical airborne SZ/BZ buried minefield detection.

FY 2007 Plans:

-Continue system development for OTH deployment of UUV systems by ASVs and large UUVs.
-Continue development of multi-platform fusion of AV-15 Kingfisher data and those from high-resolution mine hunting systems (e.g. AN/AQS-20 and submarine-launched mine warfare (MIW) UUVs) for improved mine detection and avoidance.
-Continue development of buried minefield detection capability for tactical airborne SZ/BZ buried minefield detection.
-Demonstrate combined LSG and dual frequency SAS sensor suite in a UUV in a Fleet exercise.
-Initiate multiple unmanned system data fusion for reduction in false alarms and reduction in tactical timelines.

	FY 2004	FY 2005	FY 2006	FY 2007
MINE/OBSTACLE NEUTRALIZATION	11,941	12,469	9,749	7,317

Mine and Obstacle Neutralization is focused on dramatically improving the capability to neutralize mines and obstacles from deep water through the beach exit zone. Efforts include the development of technologies for: stand-off breaching of mines and obstacles in the surf and beach zones (SZ/BZ); minesweeping of sea mines; and expendable, autonomous neutralization of sea mines. Stand-off breaching efforts will demonstrate a mine and obstacle breaching capability that is enabled by precision weapon guidance and Intelligence, Surveillance, and Reconnaissance (ISR), and delivered by Naval Tactical Aircraft (TACAIR), USAF Bombers, and Naval guns. In the near-term, tactical performance of existing unitary bombs will be demonstrated. Far-term effort will

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2917 PROJECT TITLE: MINE & EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

demonstrate a tactical countermine dart and dispenser concept. The minesweeping effort will develop a mission package for deployment on Unmanned Surface Vehicles (USVs). Commencing in FY07, an expendable, autonomous underwater neutralizer capability for deep and shallow water sea mines will be developed. This activity supports the development and transition of technologies for the OMCM FNC.
Budget for Mine/Obstacle Neutralization reflects TOG-approved funding for Organic Mine Countermeasures FNC.

FY 2004 Accomplishments:

-Continued development and demonstration of dispensing technologies using sled and horizontal gun testing for air-delivered and naval gun-delivered darts.
-Continued development of mine influence sweep payload (spiral 1) for USV mine influence sweeping.
-Continued performance characterization of Mk-84 bombs against buried mines.
-Completed demonstration of tactical effectiveness of Mk-84 bombs (USAF delivered), Joint Direct Attack Munition (JDAM) to clear a BZ lane of light obstacles and proud mines.
-Completed static water effects testing (height of detonation at tactical impact) to characterize Mk-84 bomb lethality against SZ mines and light obstacles.
-Completed high explosive dart lethality demonstrations against SZ and BZ mines (proud and buried).
-Completed separate BZ and SZ chemical dart lethality demonstrations against proud and buried mines.
-Completed 1st flight test of the Mine and Obstacle Defeat System (MODS) with a full payload of inert darts.
-Completed USV tow testing to determine mine influence sweep speed attributes.
-Initiated development of an Assault Breaching Mission Planning Tool for fleet operations using precision guided bombs against mines and obstacles and began integration of Mk-84 bomb lethality data for proud mines and obstacles into the Mine Warfare Decision Aid Library (MEDAL).

FY 2005 Plans:

-Complete development of an Assault Breaching Mission Planner, demonstrate utility with MEDAL, and begin transition to PMS-495.
-Complete performance characterization of Mk-84 bombs against buried mines.
-Complete development of USV minesweeping payload (spiral 1) and complete integration on a USV; conduct technology demonstration of mine influence sweep payload performance; conduct initial fleet demonstration of early USV mine sweeping capability from a High Speed Vehicle (HSV).
-Conduct demonstration of dart dispensing technologies and integration of payload and delivery platforms for system level demonstrations and conduct 2nd flight test of the MODS with a full payload of inert darts.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2917 PROJECT TITLE: MINE & EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

-Initiate dart fabrication and begin planning FY06 MODS “live” payload demonstration.
-Initiate development of USV minesweeping module concept for the Littoral Combat Ship (LCS).
-Initiate development of mechanical designs for neutralization of moored and bottom mines in VSW.

FY 2006 Plans:

-Complete dart fabrication and complete MODS flight demonstration of the dispensing of live darts against live tactical mines.
-Complete development and demonstration of USV minesweeping module concept and begin transition to PMS-495/PMS-420 for LCS flight 0.
-Complete mechanical designs for neutralization of bottom and moored mines in VSW then implement and test.
-Initiate and Complete integration of Mk-84 bomb lethality data for proud and buried mines and obstacles into the Joint Munitions Effectiveness Manuals (JMEM).
-Initiate the transition of countermine dart warhead technology to PMS-495.
-Initiate countermine dart lethality optimization in coordination with PMS-495.
-Initiate countermine dart dispensing optimization in coordination with PMS-495
-Initiate development of low drag, low frequency sound source for mine influence sweeping.
-Initiate development of advanced mine influence sweeping payload for USVs, focusing on increasing swept path and endurance.

FY 2007 Plans:

-Continue development of advanced mine influence sweeping payload for USVs.
-Continue development of low drag, low frequency sound sources for mine influence sweeping.
-Complete countermine dart lethality optimization.
-Complete transition countermine dart technology to PMS-495.
-Complete countermine dart dispensing optimization and complete transition of dart dispensing technology to PMS-495.
-Initiate development of an expendable, autonomous underwater vehicle neutralizer, initially focused on neutralization of moored influence sea mines in shallow water.
-Initiate development of advanced influence minesweeping module for unmanned surface vehicle mine sweeping.
-Initiate development of precision navigation capability for targeting and safe navigation through assault lanes.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2917 PROJECT TITLE: MINE & EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

-Initiate development of stand-off, assault breaching warhead fuse to extend effectiveness of unitary warheads to greater water depths.

	FY 2004	FY 2005	FY 2006	FY 2007
LITTORAL COMBAT	4,757	4,325	6,500	11,916

Within the Naval Transformation Roadmap, this investment supports achievement of transformational capabilities of Ship To Objective Maneuver (STOM), a key transformational capability within Sea Strike. This activity develops and demonstrates prototype capability to enable Naval Expeditionary Forces to influence operations ashore. The goal of Littoral Combat is the application of technologies to enhance the ability of the Navy/Marine Corps team to execute the naval portion of a joint campaign in the littorals. This activity considers all the critical functions of warfighting: command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR), fires, maneuver, sustainment, force protection, and training. This activity includes Littoral Combat Power Projection FNC investments formerly included in Mine/Obstacle Detection, such as Hostile Fire Detection and Response Spirals 1 and 2, Improvised Explosive Devices Spirals 1 and 2, Modular Scalable Weapon, Advanced Naval Fires Technology Spiral 1, and Position Location Information. It was split out to provide improved detail of the underlying investment. Budget for Littoral Combat reflects TOG-approved funding for Organic Mine Countermeasures FNC.

FY 2004 Accomplishments:

-Continued development of advanced sensing algorithms to derive maps using digital imagery from airborne ISR assets to support expeditionary maneuver. (FY05 effort funded in PE 0602782N; effort continues in this PE in FY 06)
-Initiated development of technologies to improve the functionality of fires coordination within the weapon systems/platforms of expeditionary forces.
-Initiated development of planar/phased array electronic attack antenna technology.

FY 2005 Plans:

-Continue development of fires coordination and fire control system software/hardware for indirect fire weapons systems.
-Continue development of advanced lightweight materials for weapon systems/platforms. (Previous efforts funded by PE 0603640M)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2917 PROJECT TITLE: MINE & EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

-Continue development of lightweight mission essential computational fire control interfaces for weapons systems. (Previous efforts funded by PE 0603640M)
-Continue development of improved fire control technologies for weapon aiming and pointing systems. (Previous efforts funded by PE 0603640M, 0602236N and PE 0603236N.)
-Continue development of radio frequency (RF) emitter identification and geolocation technology. (Previous efforts funded by PE 0602131M)
-Continue integration and demonstration of secure mobile networks/secure wireless local area network (LAN) communication technologies. (Previous efforts funded by PE 0602782N and PE 0602131M)
-Continue development of planar/phased array electronic attack antenna technology.
-Complete development of an advanced sensor miniature digital data link. (Development also funded by PE 0602782N)

FY 2006 Plans:

-Continue development of fires coordination and control system software/hardware for indirect fire weapons systems.
-Continue development of advanced lightweight materials for weapon systems/platforms.
-Continue development of lightweight mission essential computational interfaces for weapons systems. (FY07 effort funded by PE 0603640M)
-Continue development of improved fire control technologies for weapon aiming and pointing systems. (FY07 effort funded by PE 0603236N)
-Continue integration, development and demonstration of secure mobile networks/secure wireless LAN communication technologies. (FY07 effort funded by PE 0603640M)
-Continue advanced naval fires technology development Spiral 1. (Previous efforts funded by PE 0602131M and PE 0603640M; FY07 effort funded by PE 0603236N)
-Continue development of advanced ammunition packaging. (Previous and concurrent funding by PE 0602131M and PE 0603640M; FY07 effort funded by PE 0603640M)
-Continue hostile fire detection and response technology development (including Gunslinger). (Previous efforts funded by PE 0602131M)
-Continue development of enhanced sensor fusion Measurement and Signatures Intelligence (MASINT) capabilities. (Previous efforts funded by PE 0603640M; FY07 effort funded by PE 0603640M)
-Continue development of radio frequency (RF) emitter identification and geolocation technology.
-Complete development/testing/demonstration of Signals Intelligence (SIGINT) visualization system technologies in support of Ship to Objective Maneuver (STOM). (Previous efforts funded by PE 0603640M)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2917 PROJECT TITLE: MINE & EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

-Complete development of planar/phased array electronic attack antenna technology.
-Complete development of advanced sensing algorithms to derive maps using digital imagery and transition to Program of Record. (Previous effort funded by PE 0602131M)
-Initiate development of innovative tactical Global Information Grid (GIG)-compliant networking technologies.

FY 2007 Plans:

-Continue design and development of rocket propelled grenade (RPG) defensive systems. (Previous efforts funded by PE 0602782N)
-Continue development of innovative tactical beyond line of sight (BLOS) GIG-compliant networking technologies.
-Continue development of advanced lightweight materials for weapon systems/platforms.
-Continue development of insensitive munitions capable MCM systems. (Previous efforts funded by PE 0602131M)
-Continue development of technologies for automated control of large sensor networks for Distributed Common Ground Station (DCGS). (Previous efforts funded by PE 0602131M).
-Complete development of fires coordination and fire control system software/hardware for indirect fire weapons systems.
-Complete Gunslinger Hostile Fire Detection demonstration and integration.
-Complete development of radio frequency (RF) emitter identification and geolocation technology.
-Initiate development of conformal/phased array electronic attack antenna (high-power & broadband) technology.

	FY 2004	FY 2005	FY 2006	FY 2007
ASSAULT BREACHING SYSTEM	5,517	0	0	0

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

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2917 PROJECT TITLE: MINE & EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

FY 2004 Accomplishments:

-Continued development and demonstration of reconnaissance technologies for detecting minefields in the surf zone.
-Conducted tradeoff analysis including systems that can provide a precision mine and obstacle breaching capability delivered by Naval Tactical Aircraft, United States Air Force Bombers, and Naval Guns.

FY 2005 Plans:

-Not applicable.

FY 2006 Plans:

-Not applicable.

FY 2007 Plans:

-Not applicable.

C. OTHER PROGRAM FUNDING SUMMARY:
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 (US 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)

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: R2917 PROJECT TITLE: MINE & EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

D. ACQUISITION STRATEGY:
Not applicable.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

CONGRESSIONAL PLUS-UPS:

R2720	FY 2004	FY 2005
OCEAN MODELING FOR MINE AND EXPEDITIONARY WARFARE	961	0

This effort developed a fully-functioning web site populated with hourly moored buoy data, weather information, satellite data, model-output and forecasts, and portals to similar information at other ocean observing sites nationally.

R9166	FY 2004	FY 2005
MODELING THE WARRIOR AS A COGNITIVE SYSTEM - PHASE II	1,646	1,684

In FY04, this effort initiated the design and implementation of new technologies for modeling warrior competencies and capabilities across operations, support and training. In FY05, plans include expanding the scope of the effort to include emerging missions to better understand the warrior's human factors and development of situation-specific models.

R9343	FY 2004	FY 2005
AUGMENTED REALITY PROGRAM	1,203	0

This effort supported the development of an Augmented Reality program (ARVCOP – Augmented Reality Visualization of the Common Operational Picture) to enhance maritime navigation (including amphibious operations), operational security, and harbor defense.

R9344	FY 2004	FY 2005
EXTREME TERRAIN MEDICAL EVACUATION VEHICLE PILOT	1,636	0

This effort supports the design, development and prototyping of a medical evacuation ground transport platform suitable for use on uneven terrain and is internally air transportable in the MV-22 (Osprey) tilt rotor aircraft.

BUDGET ACTIVITY: 03
PROGRAM ELEMENT: 0603782N PROGRAM ELEMENT TITLE: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY
PROJECT NUMBER: Various PROJECT TITLE: Congressional Plus-Ups

R9345	FY 2004	FY 2005
HYPERSPECTRAL IMAGER FOR THE COASTAL OCEAN (HICO)	1,923	0

This effort developed a hyperspectral Earth and Space imager for deployment on the international space station (ISS).

R9561	FY 2004	FY 2005
COUNTERMINE LIDAR UAV-BASED SYSTEM (CLUBS)	0	991

This effort develops Light Detection and Ranging (LIDAR) technology to support the detection of mines and obstacles in the Surf Zone from an Unmanned Aerial Vehicle (UAV).