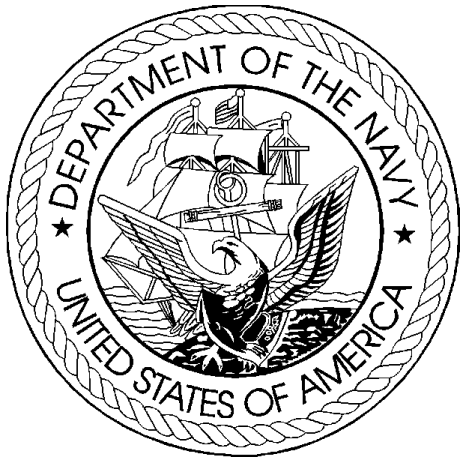
DEPARTMENT OF THE NAVY
FISCAL YEAR (FY) 2010
BUDGET ESTIMATES



JUSTIFICATION OF ESTIMATES
MAY 2009

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

PAGE INTENTIONALLY BLANK

Research, Development, Test and Evaluation, Navy

For expenses necessary for basic and applied scientific research, development, test and evaluation, including maintenance, rehabilitation, lease, and operation of facilities and equipment, $19,378,112,000, to remain available for obligation until September 30, 2011.

PAGE INTENTIONALLY BLANK

Department of the Navy
FY 2010/2011 President's Budget
Exhibit R-1 FY 2010 Base and Overseas Contingency Operations (OCO) Request
Summary
(Dollars in Thousands)

05 MAY 2009

Summary Recap of Budget Activities	FY 2008 Base&OCO Actuals	FY 2009 Base&OCO SupReq 4/9/09	FY 2010 Base	FY 2010 OCO	FY 2010 Total
Basic Research	490,457	545,866	531,291		531,291
Total Research, Development, Test & Eval, Navy	490,457	545,866	531,291		531,291

Summary Recap of FYDP Programs

Research and Development	490,457	545,866	531,291		531,291
Classified Programs					
Total Research, Development, Test & Eval, Navy	490,457	545,866	531,291		531,291

Exhibit R-1Q: FY 2010 Base and Overseas Contingency Operations (OCO) Request, as of May 5, 2009 at 14:11:06

* Reflects $30.510 million of a proposed $2.9 billion cancellation from the Department’s base budget (the Consolidated Security, Disaster Assistance, and Continuing Appropriations, Act 2009, (Public Law 110-329), for fuel savings to offset a portion of the additional Emergency Requests in FY 2009 Overseas Contingency Operations Supplemental Request (Acceleration/Grow the Force, Family Support, and National Capital Region Acceleration). Also reflects a $5.0 million cancellation for certain classified programs that are now excess to requirements.

Department of the Navy
FY 2010/2011 President's Budget
Exhibit R-1 FY 2010 Base and Overseas Contingency Operations (OCO) Request
(Dollars in Thousands)

APPROPRIATION: 1319N Research, Development, Test & Eval, Navy — Date: 05 MAY 2009

Line No	Program Element Number	Item	Act	FY 2008 Base&OCO Actuals	FY 2009 Base&OCO SupReq 4/9/09	FY 2010 Base	FY 2010 OCO	FY 2010 Total	SEC
1	0601103N	University Research Initiatives	01	96,672	108,612	99,472		99,472	U
2	0601152N	In-House Laboratory Independent Research	01	16,390	17,251	18,076		18,076	U
3	0601153N	Defense Research Sciences	01	377,395	420,003	413,743		413,743	U
	Basic Research			490,457	545,866	531,291		531,291	
	Total Research, Development, Test & Eval, Navy			490,457	545,866	531,291		531,291	

Exhibit R-1Q: FY 2010 Base and Overseas Contingency Operations (OCO) Request, as of May 5, 2009 at 14:11:06

* Reflects $30.510 million of a proposed $2.9 billion cancellation from the Department’s base budget (the Consolidated Security, Disaster Assistance, and Continuing Appropriations, Act 2009, (Public Law 110-329), for fuel savings to offset a portion of the additional Emergency Requests in FY 2009 Overseas Contingency Operations Supplemental Request (Acceleration/Grow the Force, Family Support, and National Capital Region Acceleration). Also reflects a $5.0 million cancellation for certain classified programs that are now excess to requirements.

Department of the Navy
FY 2010/2011 President's Budget
Exhibit R-1 FY 2010 Base and Overseas Contingency Operations (OCO) Request
Summary
(Dollars in Thousands)

05 MAY 2009

Summary Recap of Budget Activities	FY 2008 Base&OCO Actuals	FY 2009 Base&OCO SupReq 4/9/09	FY 2010 Base	FY 2010 OCO	FY 2010 Total
Applied Research	787,514	774,095	593,975		593,975
Total Research, Development, Test & Eval, Navy	787,514	774,095	593,975		593,975

Summary Recap of FYDP Programs

Research and Development	787,514	774,095	593,975		593,975
Classified Programs					
Total Research, Development, Test & Eval, Navy	787,514	774,095	593,975		593,975

Exhibit R-1Q: FY 2010 Base and Overseas Contingency Operations (OCO) Request, as of May 5, 2009 at 14:12:21

* Reflects $30.510 million of a proposed $2.9 billion cancellation from the Department’s base budget (the Consolidated Security, Disaster Assistance, and Continuing Appropriations, Act 2009, (Public Law 110-329), for fuel savings to offset a portion of the additional Emergency Requests in FY 2009 Overseas Contingency Operations Supplemental Request (Acceleration/Grow the Force, Family Support, and National Capital Region Acceleration). Also reflects a $5.0 million cancellation for certain classified programs that are now excess to requirements.

Department of the Navy
FY 2010/2011 President's Budget
Exhibit R-1 FY 2010 Base and Overseas Contingency Operations (OCO) Request
(Dollars in Thousands)

APPROPRIATION: 1319N Research, Development, Test & Eval, Navy — Date: 05 MAY 2009

Line No	Program Element Number	Item	Act	FY 2008 Base&OCO Actuals	FY 2009 Base&OCO SupReq 4/9/09	FY 2010 Base	FY 2010 OCO	FY 2010 Total	S E C
4	0602114N	Power Projection Applied Research	02	103,744	98,834	59,787		59,787	U
5	0602123N	Force Protection Applied Research	02	183,653	186,870	91,400		91,400	U
6	0602131M	Marine Corps Landing Force Technology	02	31,258	42,864	39,308		39,308	U
7	0602234N	Materials, Electronics and Computer Technology	02	1,931	7,280				U
8	0602235N	Common Picture Applied Research	02	105,732	85,235	83,163		83,163	U
9	0602236N	Warfighter Sustainment Applied Research	02	100,864	115,767	104,169		104,169	U
10	0602271N	Electromagnetic Systems Applied Research	02	60,187	59,682	64,816		64,816	U
11	0602435N	Ocean Warfighting Environment Applied Research	02	52,499	51,538	48,750		48,750	U
12	0602651M	Joint Non-Lethal Weapons Applied Research	02	5,974	6,067	6,008		6,008	U
13	0602747N	Undersea Warfare Applied Research	02	71,841	65,241	55,694		55,694	U
14	0602782N	Mine and Expeditionary Warfare Applied Research	02	69,831	54,717	40,880		40,880	U
		Applied Research		787,514	774,095	593,975		593,975	
		Total Research, Development, Test & Eval, Navy		787,514	774,095	593,975		593,975	

Exhibit R-1Q: FY 2010 Base and Overseas Contingency Operations (OCO) Request, as of May 5, 2009 at 14:12:21

* Reflects $30.510 million of a proposed $2.9 billion cancellation from the Department’s base budget (the Consolidated Security, Disaster Assistance, and Continuing Appropriations, Act 2009, (Public Law 110-329), for fuel savings to offset a portion of the additional Emergency Requests in FY 2009 Overseas Contingency Operations Supplemental Request (Acceleration/Grow the Force, Family Support, and National Capital Region Acceleration). Also reflects a $5.0 million cancellation for certain classified programs that are now excess to requirements.

Department of the Navy
FY 2010/2011 President's Budget
Exhibit R-1 FY 2010 Base and Overseas Contingency Operations (OCO) Request
Summary
(Dollars in Thousands)

05 MAY 2009

Summary Recap of Budget Activities	FY 2008 Base&OCO Actuals	FY 2009 Base&OCO SupReq 4/9/09	FY 2010 Base	FY 2010 OCO	FY 2010 Total
Advanced Technology Development	743,180	833,342	720,896		720,896
Total Research, Development, Test & Eval, Navy	743,180	833,342	720,896		720,896
Summary Recap of FYDP Programs					
Research and Development	743,180	833,342	720,896		720,896
Classified Programs					
Total Research, Development, Test & Eval, Navy	743,180	833,342	720,896		720,896

Exhibit R-1Q: FY 2010 Base and Overseas Contingency Operations (OCO) Request, as of May 5, 2009 at 14:13:17

* Reflects $30.510 million of a proposed $2.9 billion cancellation from the Department’s base budget (the Consolidated Security, Disaster Assistance, and Continuing Appropriations, Act 2009, (Public Law 110-329), for fuel savings to offset a portion of the additional Emergency Requests in FY 2009 Overseas Contingency Operations Supplemental Request (Acceleration/Grow the Force, Family Support, and National Capital Region Acceleration). Also reflects a $5.0 million cancellation for certain classified programs that are now excess to requirements.

Department of the Navy
FY 2010/2011 President's Budget
Exhibit R-1 FY 2010 Base and Overseas Contingency Operations (OCO) Request
(Dollars in Thousands)

APPROPRIATION: 1319N Research, Development, Test & Eval, Navy — Date: 05 MAY 2009

Line No	Program Element Number	Item	Act	FY 2008 Base&OCO Actuals	FY 2009 Base&OCO SupReq 4/9/09	FY 2010 Base	FY 2010 OCO	FY 2010 Total	S E C
15	0603114N	Power Projection Advanced Technology	03	94,020	81,907	107,969		107,969	U
16	0603123N	Force Protection Advanced Technology	03	125,869	113,543	66,035		66,035	U
17	0603235N	Common Picture Advanced Technology	03	94,939	90,080	108,394		108,394	U
18	0603236N	Warfighter Sustainment Advanced Technology	03	90,353	137,507	86,239		86,239	U
19	0603271N	Electromagnetic Systems Advanced Technology	03	43,599	55,867	65,827		65,827	U
20	0603640M	USMC Advanced Technology Demonstration (ATD)	03	90,671	103,333	107,363		107,363	U
21	0603651M	Joint Non-Lethal Weapons Technology Development	03	10,667	12,985	10,998		10,998	U
22	0603729N	Warfighter Protection Advanced Technology	03	50,670	53,783	18,609		18,609	U
23	0603747N	Undersea Warfare Advanced Technology	03	73,123	83,632	68,037		68,037	U
24	0603758N	Navy Warfighting Experiments and Demonstrations	03	41,100	66,173	52,643		52,643	U
25	0603782N	Mine and Expeditionary Warfare Advanced Technology	03	28,169	34,532	28,782		28,782	U
		Advanced Technology Development		743,180	833,342	720,896		720,896	
		Total Research, Development, Test & Eval, Navy		743,180	833,342	720,896		720,896	

Exhibit R-1Q: FY 2010 Base and Overseas Contingency Operations (OCO) Request, as of May 5, 2009 at 14:13:17

* Reflects $30.510 million of a proposed $2.9 billion cancellation from the Department’s base budget (the Consolidated Security, Disaster Assistance, and Continuing Appropriations, Act 2009, (Public Law 110-329), for fuel savings to offset a portion of the additional Emergency Requests in FY 2009 Overseas Contingency Operations Supplemental Request (Acceleration/Grow the Force, Family Support, and National Capital Region Acceleration). Also reflects a $5.0 million cancellation for certain classified programs that are now excess to requirements.

Department of the Navy
FY 2010 President's Budget
(Dollars in Thousands)
FY 2009 Proposed Fuel Cancellations

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

Line No	Program Element Number	Item	Act	FY 2009	SEC
2	0601152N	In-House Lab Independent Res	01	-44	U
3	0601153N	Defense Research Sciences	01	-64	U
4	0602114N	Power Proj Applied Research	02	-183	U
5	0602123N	Force Protection Applied Res	02	-120	U
6	0602131M	Marine Corps Lndg Force Tech	02	-6	U
8	0602235N	Common Picture Applied Research	02	-26	U
9	0602236N	Warfighter Sustainment Applied Res	02	-67	U
10	0602271N	Electromagnetic Systems Applied Research	02	-14	U
12	0602651M	JT Non-Lethal Wpns Applied Res	02	-2	U
13	0602747N	Undersea Warfare Applied Res	02	-54	U
14	0602782N	Mine & Exp Warfare Applied Res	02	-28	U
15	0603114N	Power Projection Advanced Technology	03	-232	U
16	0603123N	Force Protection Advanced Technology	03	-41	U
17	0603235N	Common Picture Advanced Technology	03	-30	U
18	0603236N	Warfighter Sustainment Advd Tech	03	-49	U
19	0603271N	Electromagnetic Systems Advanced Technology	03	-1	U
20	0603640M	MC Advanced Technology Demo	03	-37	U
21	0603651M	JT Non-Lethal Wpns Tech Dev	03	-1	U
22	0603729N	Warfighter Protection Adv Tech	03	-17	U
23	0603747N	Undersea Warfare Advanced Tech	03	-67	U
24	0603758N	Navy Warfighting Exp & Demo	03	-35	U
25	0603782N	Shallow Water MCM Demos	03	-31	U
	Total Research, Development, Test & Eval, Navy (BA 01-03)			-1149	

PAGE INTENTIONALLY BLANK

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research					R-1 ITEM NOMENCLATURE PE 0601103N UNIVERSITY RESEARCH INITIATIVES					
COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	96.672	108.612	99.472						Continuing	Continuing
0000: UNIVERSITY RESEARCH INITIATIVES	96.672	108.612	99.472						Continuing	Continuing

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 enable the U.S. Navy to maintain technological superiority, and for university research infrastructure to acquire research instrumentation needed to maintain and improve the quality of university research important to the Navy. Multidisciplinary University Research Initiative (MURI) efforts involve teams of researchers investigating high priority topics and opportunities 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 into 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. The program supports Presidential Early Career Awards for Scientists and Engineers (PECASE), 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.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	98.057	103.707	97.580	
Current BES/President's Budget	96.672	108.612	99.472	
Total Adjustments	-1.385	4.905	1.892	
Congressional Program Reductions		-3.295		
Congressional Rescissions				
Total Congressional Increases		8.200		
Total Reprogrammings	-0.100			
SBIR/STTR Transfer	-1.257			
FTT Assessment	-0.028			
Program Adjustments			1.892	

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601103N UNIVERSITY RESEARCH INITIATIVES

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **BLAST AND IMPACT RESISTANT COMPOSITES STRUCTURES FOR NAVY SHIPS**	1.543	0.000
Project: 9999, **CELL-BASED SENSORS FOR CHEMICAL THREATS**	1.166	0.000
Project: 9999, **CENTER FOR HETERO-FUNCTIONAL MATERIALS**	1.931	0.000
Project: 9999, **CENTER FOR NANOSCIENCE AND NANOMATERIALS (CNN)**	1.160	0.000
Project: 9999, **CENTER FOR SOUTHEASTERN TROPICAL ADVANCED REMOTE SENSING (CSTARS)**	1.928	0.000
Project: 9999, **COMPUTATIONAL MODELING AND HIGH PERFORMANCE COMPUTING IN ADVANCED MATERIAL PROCESSING, SYNTHESIS AND DESIGN**	0.000	1.197
Project: 9999, **HUMAN NEURAL CELL-BASED BIOSENSOR**	0.000	0.997
Project: 9999, **LOW ACOUSTIC AND THERMAL SIGNATURE BATTLEFIELD POWER SOURCE**	1.928	1.994
Project: 9999, **NATIONAL SECURITY TRAINING**	1.928	1.596
Project: 9999, **NEXT GENERATION AUTOMATED TECHNOLOGY FOR LANDMINE DETECTION**	0.000	1.596
Project: 9999, **RADIATION HARDNESS AND SURVIVABILITY OF ELECTRONIC SYSTEMS**	0.000	0.798
Project: 9999, **RESEARCH INFRASTRUCTURE FOR THE APPLIED PHYSICS LABORATORY**	3.088	0.000
Project: 9999, **UNIVERSITY RESEARCH INITIATIVES**	7.713	0.000

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601103N UNIVERSITY RESEARCH INITIATIVES					PROJECT NUMBER 0000	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
0000: UNIVERSITY RESEARCH INITIATIVES	96.672	108.612	99.472						Continuing	Continuing

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 to acquire instrumentation needed to maintain and improve the quality of university research important to the Navy. MURI 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 into Naval applications. The DURIP project supports university research infrastructure essential to high quality Navy relevant research. The instrumentation project complements other Navy research programs by supporting the purchase of high cost research instrumentation that is necessary to carry out cutting-edge research. The PECASE project supports 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 ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
DEFENSE UNIVERSITY RESEARCH INSTRUMENTATION PROGRAM	22.670	30.594	19.302	
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 $50K to $1M. The DURIP program is an OSD interest item and OSD directs that funding for the DURIP efforts be awarded after OSD announces the awardees, which typically takes place towards the second half of the fiscal year. In turn, universities need to purchase the instrumentation and take delivery before any billings are generated. It frequently takes several months for delivery and billing to be completed. The increase from FY 2008 to FY 2009 is due to the number of awards increasing from 55 to 113. The program decreases in FY 2010 and again in FY 2011 to allow for the steady increase in the MURI and PECASE programs.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601103N UNIVERSITY RESEARCH INITIATIVES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2008 Accomplishments: - Conducted competition for 55 research instrumentation awards to universities. *FY 2009 Plans:* - Conduct competition for research instrumentation awards to universities. *FY 2010 Plans:* - Conduct competition for research instrumentation awards to universities.					
MULTIDISCIPLINARY UNIVERSITY RESEARCH INITIATIVE (MURI) Research efforts include high priority topics that intersect more than one traditional discipline. MURI topics are selected to address Naval S&T Focus Areas as described in the Naval S&T Strategic Plan. The MURI program is an OSD interest item and OSD directs that funding for the MURI efforts be awarded after OSD announces the awardees, which typically takes place towards the second half of the fiscal year. Since the MURI program funds academic researchers, execution of the efforts typically ramps up during the summer academic break months. MURI projects make significant contributions to Navy and DoD objectives by; speeding up scientific programs by cross-fertilization of ideas, hastening the transition of basic research to practical applications, and training students in cross-disciplinary approaches to science and engineering research of importance to DoD. The increase from FY 2008 through FY 2010 is due to OSD direction to increase peer-reviewed basic research in order to develop innovative solutions and to enhance the science and engineering personnel base. *FY 2008 Accomplishments:* - Conducted competition for $5,615K of new MURI awards addressing selected high priority naval science and technology areas, transformational activities, and grand challenges, including strategically important DoD research areas. Six topics were identified for publication via Broad Agency		51.006	66.822	73.850	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601103N UNIVERSITY RESEARCH INITIATIVES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Announcement (BAA) to solicit proposals. These topics addressed electronic device reliability, analysis of networks, autonomous sea vehicles, asymmetric threat environment, biometrics in the marine domain, and unmanned systems for surveillance over large and complex areas. Remaining balance was spent to continue MURI projects begun in prior years. *FY 2009 Plans:* - Conduct competition for 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 six high priority research topics will be identified for publication in a BAA to solicit proposals. Remaining balance will be spent to continue MURI projects begun in prior years. *FY 2010 Plans:* - Conduct competition for 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 seven high priority research topics will be identified for publication in a BAA to solicit proposals. Remaining balance will be spent to continue MURI projects begun in prior years.					
PRESIDENTIAL EARLY CAREER AWARDS PECASE awards are made to academic scientists early in their research career for extremely prestigious single-investigator research in areas of vital importance to DoN. Awards provide national recognition and research grants of $200K per year for five years. OSD, with policy and oversight responsibility for the PECASE program, directed that the value of PECASE awards be increased from $100K to $200K per year and that the DoN limit for the number of PECASE awards each year be increased from two to ten. An increase in award size permits outstanding early career researchers to focus fully on DoD problems, build long-term relationships with Navy and train more graduate students in relevant fields. An increase in the number of awards permits a larger number of these outstanding researchers to contribute to the DoN S&T requirements.		0.611	3.018	6.320	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601103N UNIVERSITY RESEARCH INITIATIVES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
The increase in funding from FY 2008 through FY 2010 reflects ramp up of these five year awards from $100K per year to $200K per year, and increase in award selections from two in FY 2008 to nine in FY 2009, and to ten award selections of FY 2010. *FY 2008 Accomplishments:* - Selected two outstanding university researchers to receive the five-year PECASE research awards to conduct research of importance to the Navy. Continued PECASE programs begun in earlier years. *FY 2009 Plans:* - Select nine 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 2010 Plans:* - Select 10 outstanding university researchers to receive the five-year PECASE research award to conduct research of importance to the Navy. Continue PECASE programs begun in earlier years.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601103A/University Research Initiatives									Continuing	Continuing
PE 0601103F/University Research Initiatives									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing

D. Acquisition Strategy

Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601103N UNIVERSITY RESEARCH INITIATIVES	PROJECT NUMBER 0000

E. Performance Metrics

This University Research Initiative seeks to improve the quality of defense research conducted by universities and supports the education of engineers and scientists in disciplines critical to national defense needs. The initiative is a collection of specialized research programs performed by academic research institutions. Individual project metrics are tailored to the needs of specific applied research and advanced development programs. Example metrics include extending the life of Thermal Barrier Coatings for transition to the Enterprise and Platform Enablers Future Naval Capability program. It is projected that the life time of Thermal Barrier Coating on Turbine Blades can be doubled. The National Research Council of the National Academies of Science and Engineering's Congressionally directed "Assessment of Department of Defense Basic Research" concluded that the DoD is managing its basic research program effectively.

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research					R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	16.390	17.207	18.076						Continuing	Continuing
0000: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	16.390	17.207	18.076						Continuing	Continuing

A. Mission Description and Budget Item Justification

This program element (PE) 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 (FNCs). The Department of Navy (DON) component responds to S&T directions of the Naval S&T Strategic Plan 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. The In-house Laboratory Independent Research (ILIR) program also adds increased emphasis to the revitalization of the scientist and engineer workforce component at the Navy's Warfare Centers and Laboratories by attracting superior candidates and retaining our best members through the provision of exciting and meaningful work.

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 thirteen research focus areas: Power and Energy; Operational Environments; Maritime Domain Awareness; Asymmetric and Irregular Warfare; Information, Analysis and Communication; Power Projection; Assure Access and Hold at Risk; Distributed Operations; Naval Warfighter Performance and Protection; Survivability and Self-Defense; Platform Mobility; Fleet/Force Sustainment; Affordability, maintainability and Reliability.

This portion of the DON Basic Research Program provides participating Naval Warfare Centers and Laboratories with funding for: basic research to support the execution of their assigned missions; developing and maintaining a cadre of active researchers who can distill and extend results from worldwide research and apply them to solve 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.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	**R-1 ITEM NOMENCLATURE** PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)

ILIR efforts are selected by Naval Warfare Centers/Lab COs and TDs near the start of each Fiscal Year through internal competition. Efforts typically last three years, and are generally designed to assess the promise 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.

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

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	16.403	17.298	18.285	
Current BES/President's Budget	16.390	17.207	18.076	
Total Adjustments	-0.013	-0.091	-0.209	
Congressional Program Reductions		-0.047		
Congressional Rescissions				
Total Congressional Increases				
Total Reprogrammings	0.010			
SBIR/STTR Transfer	-0.023			
Program Adjustments			-0.219	
Rate/Misc Adjustments		-0.044	0.010	

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)					PROJECT NUMBER 0000	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
0000: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	16.390	17.207	18.076						Continuing	Continuing

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 mitigates scientific surprises, while exploiting scientific breakthroughs and providing options for new Future Naval Capabilities. It responds to S&T directions of the Naval S&T Strategic Plan 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 (NWDC) and the Marine Corps Combat Development Command (MCCDC), and enables technologies to significantly improve the Joint Chiefs of Staff's Future Joint Warfighting Capabilities.

This portion of the DON Basic Research Program provides participating Naval Warfare 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.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
ADVANCED MATERIALS	3.117	3.301	3.557	
Efforts include: Structural materials; functional materials; maintenance reduction, hydrodynamics; power generation; energy conservation and conversion.				
FY 2008 Accomplishments: - Continued research to investigate a radical new technique for producing structures that have reconfigurable embedded functionality based on chemistry and nanotechnology. The research centers on the creation of “MicroConduit Network” (MCN) which is a series of interconnected micron-size channels designed to permeate thought the structure and occupy the smallest volume fraction, to preserve the strength and stiffness of the structure.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued research to quantify the Small Angle X-ray Scattering (SAXS) and tensile mechanical tests the structural transition to the mechanical mechanism for protective response to different polyurea chemistries. Continue to characterize the response limits in terms of strain and high strain rates (10E-1s – 10E4/s) to ensure specific impact loading levels in the protective range of the polyurea coatings. - Continued research in the field of fuel cell membranes, chemical analysis and biological transport requires the understanding of the conduction and electrical mechanisms through porous membranes. The research has revealed unusual and enhanced conduction properties in pores with widths that are less than 1um; exceeding the diameter by which the current theory predicts. The research will exploit the enhanced current where there exists the potential for order-of-magnitude improvements in sensors, computation and communications. - Continued research from a previously sponsored ILIR project that produced the scientific foundation of a new technology for the expitaxial deposition of lattice-mismatched films on substrates of silicon (Si) and gallium arsenide (GaAs). The technology features the formation of an atomic layer or template that serves as the interface between the film and substrate. It was discovered that the layer formation happens when there is a chemical reaction between the substrate and the impinging molecules. This research will focus on the hypothesis that instead of fusion, the impinging molecules come in sequence with a narrow distribution of velocities than an ideal gas with lower overall entropy. - Completed research to seek a substrate to maximize the Surface Enhanced Raman Spectroscopy (SERS) effect. The SERS effect has been shown to be dependent on nanostructure size and distance between neighbors. SERS has been studied using roughened surfaces, nanocolloids, deposited films, electrode tips, metal islands, and a few other variations. The research sought to deposit Self-Assembled Monolayer's (SAMs) of conducting organic molecules on a gold surface and attach gold nanoparticles to the SAMs. The distance between nanoparticles was optimized to create SERS "hot spots" by varying the concentration and length of the molecules. - Completed research to identify a method of protecting underwater structures from bio-fouling without using toxins. Utilizing conductive polymers (piezoelectric), plastic films technology, nano-release mechanisms and non-chromate metal finishing indicated that the technology is mature enough to mimic natural non-toxic antifouling methods on artificial structures with added benefit of electric fields and piezoelectric movement.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Completed research on microstructure development of cast titanium Ti-5111 that determined critical features to control the strength and fracture toughness of the alloy. Strategic heat treatments were conducted, and two optimum heat treatment conditions were developed that show fracture toughness values greater than the wrought product while still maintaining good strength and ductility. An understanding of how the fracture toughness and ultimate strength of the material varies with types of grains, grain size and orientation was developed. This is particularly important for thin-walled pressure hulls where the grains of poorer quality can span the thickness of the hull and lead to lower strength structures than expected. - Initiated research and development on energy flow control and redirection of anisotropic cylindrical shells. This research is to reduce and redirect vibrational energy propagation through cylindrical structures by utilizing new anisotropic materials that are now available. - Initiated research and development effort to reinvestigate the nature of Cathodic Delamination (CD) problem and determine the effectiveness of new approaches to combating the old scourge of CD on naval hardware. - Initiated research in the development of an algorithm that makes us of both forward and inverse modeling techniques to determine variations in both static and dynamic material properties of hyper elastic materials from experimental measurement. The research seeks to develop a technique that combines modeling and experimental measurements to quantify spatial variations in materials response both static and dynamic loads. - Initiated research on mesoscale models to include dissipative particle dynamics and automata based modeling strategies. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Complete research to investigate a radical new technique for producing structures that have reconfigurable embedded functionality based on chemistry and nanotechnology. The research centers on the creation of MCN which is a series of interconnected micron-size channels designed to permeate thought the structure and occupy the smallest volume fraction, to preserve the strength and stiffness of the structure.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Complete research to quantify the SAXS and tensile mechanical tests the structural transition to the mechanical mechanism for protective response to different polyurea chemistries. Continue to characterize the response limits in terms of strain and high strain rates (10E-1s – 10E4/s) to ensure specific impact loading levels in the protective range of the polyurea coatings. The strain rate material response for both elastic and plastic incorporated into the constitutive equation for modeling and hydrocode simulation for further calculations of the geometries and layer thickness. - Complete the research in the field of fuel cell membranes, chemical analysis and biological transport requires the understanding of the conduction and electrical mechanisms through porous membranes. The research revealed unusual and enhanced conduction properties in pores with widths less than 1um; exceeding the diameter by which the current theory predicts. The research will exploit the enhanced current where there exists the potential for order-of-magnitude improvements in sensors, computation and communications. - Complete research from a previously sponsored ILIR project that produced the scientific foundation of a new technology for the expitaxial deposition of lattice-mismatched films on substrates of silicon (Si) and GaAs. The technology features the formation of an atomic layer or template that serves as the interface between the film and substrate. It was discovered that the layer formation happens when there is a chemical reaction between the substrate and the impinging molecules. This research will focus on the hypothesis that instead of fusion, the impinging molecules come in sequence with a narrow distribution of velocities than ideal gas with lower entropy. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. FY 2009 projects are currently going through a rigorous selection process at the naval warfare centers. Projects selected for FY 2009 will focus on supporting Naval Materials by Design and Intelligent Naval Sensors, Innovation naval Prototypes Initiatives in Electromagnetic Gun and See Basing, and National Naval Responsibility Initiatives in Undersea Weaponry and Naval Engineering. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete research and development on energy flow control and redirection of anisotropic cylindrical shells					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Complete research and development effort on the nature of CD problem in the navy and determine the effectiveness of new approaches to combating the old scourge on naval hardware. - Complete the research in the development of an algorithm that makes us of both forward and inverse modeling techniques to determine variations in both static and dynamic material properties of hyper elastic materials from experimental measurement. The research seeks to develop a technique that combines modeling and experimental measurements to quantify spatial variations in materials response both static and dynamic loads. - Complete research on mesoscale models to include dissipative particle dynamics and automata based modeling strategies. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2010 will focus on supporting Naval Materials by Design and Intelligent Naval Sensors, Innovation naval Prototypes Initiatives in Electromagnetic Gun and See Basing, and National Naval Responsibility Initiatives in Undersea Weaponry and Naval Engineering.					
ELECTRONICS SENSOR SCIENCES Efforts include: sensing, diagnostics, and detectors; navigation and timekeeping; nano electronics; real time targeting, Electro Optical/InfraRed (EO/IR) electronics; EO/IR electronic warfare; and EO/IR sensors for surface and subsurface surveillance. *FY 2008 Accomplishments:* - Continued research on new approaches, to miniaturization and the integration of optical components into compact functions systems capable of generating, localizing, detecting, amplifying, and processing light signals. The research will focus on novel coupling and beam splitting methods utilizing metallic tip and multilayer stock. The Y-Splitter is the basic components in many optical devices, such as coupling efficiency and splitting ratio. The beam splitting effect can be employed to construct a nanoplasmonic Y-splitter. Investigation into the method of beam coupling and splitting in the subwavelength scale. Nanoscale optics is expected to form the basis for future nanolithography and optical sensors, diagnostics in single- molecular level through surface plasmon enhanced ramon scattering.		2.434	2.464	2.618	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued research using mid-IR solid state laser to photo-acoustically generate large dimension, short-lived underwater filaments. Filament dimensions on the order of 10 mm in diameter and 10 cm long with durations ranging from 100 microseconds to a few milliseconds are expected as a result of using an existing laser system. The investigation could produce large dimension filaments and accompanying transient shock waves in a controlled manner could potentially revolutionize air/surface-to-underwater communications, and development of additional naval applications to support other situational awareness efforts. - Completed the research to numerically model the reduction of semiconductor laser phase noise and line width through optical injection locking and verify model developed. - Completed research on the extension of Negative Index Materials (NIM) wavelengths into the visible region. Near-field Scanning Optical Microscopy (NSOM) lithography was used in the fabrication or nanophotonic component structures. The component structure of primary interest was a layered parallel nanowire pair array separated by dielectric. Investigation incorporated material parameters derived from the Drude model. - Initiated investigation into the Space-Charge-Limited (SCL) transport of charge carriers across a potential difference. The related publications on theoretical, experimental and numerical investigations have undergone excess growth in the number of disciplines for which SCL related flows are found to be applicable. Currently SCL is playing in a classical role in the discharge and bounded of plasma devices. SCL is found to have a strong impact on ion diodes in connection with inertial fusion, diodes with cold cathode emission, field-emitter-arrays in the vacuum electronic field's semiconductor diodes and on the capabilities of photocathode guns. This research is to investigate the limitations of SCL transport and certain extension that have recently been proposed. The extensions can lead to enhancements in the amount charge and able to transport in 1-D, 2-D, and 3-D geometries. - Initiated an investigation into twin concepts of post-selection of wave function in a quantum mechanics and Aharonov-Vaidman formula that has opened up new avenues in the theory of what can and can not be measured in quantum mechanics. Each theory and experiment confirmation has proven new, previously unexpected effect in quantum mechanics and identifies a possible new area of technology. Research to translate the aspects of quantum mechanical work into a classical weak signatures (Observables) setting to determine if the effects can occur in electromagnetic and other wave theories. This research will have an enormous potential in provide new way to enhance signals that otherwise				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
would not be detectable, new types of signatures to be looked for in the traditional signal (radar) waveform returns, new phenomena – weak energy. Investigate these phenomena in the classical signals that are regularly used in naval applications such as radar, sonar and electro-optics. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Complete research on new approaches, to miniaturization and integration of optical components into compact functions systems capable of generating, localizing, detecting, amplifying, and processing light signals. The research will focus on novel coupling and beam splitting methods utilizing metallic tip and multilayer stock. The Y-Splitter is the basic component in many optical devices. The beam splitting effect can be employed to construct a nanoplasmonic Y-splitter. Nanoscale optics is expected to form the basis for future nanolithography and optical sensors, and diagnostics in the single-molecular level through surface plasmon enhanced ramon scattering. - Complete research using mid-IR solid state laser to photo-acoustically generate large dimension, short-lived underwater filaments. Filament dimensions on the order of 10 mm in diameter and 10 cm long with durations ranging from 100 microseconds to a few milliseconds are expected as a result of using an existing laser system. The investigation could produce large dimension filaments and accompanying transient shock waves in a controlled manner could potentially revolutionize air/surface-to-underwater communications, and development of additional naval applications to support other situational awareness efforts. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. FY 2009 projects are currently going through a rigorous selection process at the naval warfare centers. Projects selected for FY 2009 will focus on supporting 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 in Undersea Weaponry. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Complete the investigation into the SCL transport of charge carriers across a potential difference. The related publications on theoretical, experimental and numerical investigations have undergone excess growth in the number of disciplines for which SCL related flows are found to be applicable. Currently SCL is playing in a classical role in the discharge and bounded of plasma devices. SCL is found to have a strong impact on ion diodes in connection with inertial fusion, diodes with cold cathode emission, field-emitter-arrays in the vacuum electronic fields' semiconductor diodes and on the capabilities of photocathode guns. This research is to investigate the limitations of SCL transport and certain extension that have recently been proposed. The extensions can lead to enhancements in the amount charge and able to transport in 1-D, 2-D, and 3-D geometries. - Complete the investigation into the twin concepts of post-selection of wave function in a quantum mechanics and Aharonov-Vaidman formula that has opened up new avenues in the theory of what can and can not be measured in quantum mechanics. Each theory and experiment confirmation has proven new, previously unexpected effect in quantum mechanics and identifies a possible new area of technology. Research to translate the aspects of quantum mechanical work into a classical weak signatures (Observables) setting to determine if the effects can occur in electromagnetic and other wave theories. This research will have an enormous potential in provide new way to enhance signals that otherwise would not be detectable, new types of signatures to be looked for in the traditional signal (radar) waveform returns, new phenomena – weak energy. Investigate these phenomena in the classical signals that are regularly used in naval applications such as radar, sonar and electro-optics. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2010 will focus on supporting 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 in Undersea Weaponry.				
ENERGY SCIENCES Efforts include: undersea weaponry; energetic materials and propulsion; directed energy; and THZ-TDS technology that addresses the global war on terror and Counter Improvised Explosive Device (C-IED) (detect) tenet lane by detecting and spectroscopically identifying military and home-made explosives and formulations		1.283	1.275	1.372	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2008 Accomplishments: - Continued research on the physical properties of explosively driven, guided shock waves. An explosively driven, guided shock wave is a shock wave produced in a guide tube that was initiated by an explosive at one end of the tube. The goal of this project is explore the properties guided shock wave to include: the pressure, temperature, and velocity of the gas through which the guided shock wave travels. - Continued research in the TeraHertz Time-Domain Spectroscopy (THz-TDS) technology which addressed the Global War On Terror (GWOT) and the C-IED (detect) tenet lane by detecting and spectroscopically identifying military and home-made explosives and formulations. The continued focus of this research is to establish peak assignments of explosives in the THz regime by comparing solid-state quantum chemistry calculations that is to be measured. Results of this study will provide the fundamental THz reflection and absorption spectra of explosives found in IEDs. - Completed research on the development of a capability to monitor detonation and subsequent combustion processes with temporal, spatial and chemical sensitivity. The measurement provided in this program focused on absorption spectroscopy and related schemes aimed at concentrations of metal particles and oxides. - Completed research into the capability of detonation and subsequent combustion processes with temporal, spatial and chemistry sensitive energetic materials. This effort focused on absorption spectroscopy and related schemes aimed at concentration of metal particles and oxides. Small scale laser ablation and composite explosive experiments were used to create highly turbulent environments where optical methods can be developed. - Initiated research to develop CFD modeling techniques to support flow optimization in diving, fire fighting, Chemical, Biological, Radiological, and Nuclear (CBRN) protection, and aeronautical and aerospace life support helmets. The goal of this research is to improve CO2 transport from life support helmets to optimize performance without resorting to an oral-nasal mask. - Initiated research in the development of a theory that will describe vibrational energy transfer between the shock wave and the local vibrations/electrons of explosive molecules. The goal of this research is to provide a simplified theoretical expression for the rate of energy transfer into an explosive molecule, without lengthy molecular dynamics or quantum chemical calculations. The approach combines both				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
macroscopic thermodynamic properties and ultra fast spectroscopy data to study the initial nanosecond as the shock passes through the material. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Complete research on the physical properties of explosively driven, guided shock waves. An explosively driven, guided shock wave is a shock wave produced in a guide tube that was initiated by an explosive at one end of the tube. The goal of this project is explore the properties guided shock wave to include: the pressure, temperature, and velocity of the gas through which the guided shock wave travels. - Complete research in the THz-TDS technology which addressed the GWOT and the C-IED (detect) tenet lane by detecting and spectroscopically identifying military and home-made explosives and formulations. The continued focus of this research is to establish peak assignments of explosives in the THz regime by comparing solid-state quantum chemistry calculations that is to be measured. Results of this study will provide the fundamental THz reflection and absorption spectra of explosives found in IEDs. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. FY 2009 projects are currently going through a rigorous selection process at the naval warfare centers. Projects selected for FY 2009 will focus on supporting Naval Battlespace Awareness and Intelligent naval Sensors, Innovative Naval Prototypes Initiative in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry. *FY 2010 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Complete research to develop CFD modeling techniques to support flow optimization in diving, fire fighting, CBRN protection, and aeronautical and aerospace life support helmets. The goal of this research is to improve CO2 transport from life support helmets to optimize performance without resorting to an oral-nasal mask. - Complete research in the development of a theory that will describe vibrational energy transfer between the shock wave and the local vibrations/electrons of explosive molecules. The goal of this research is to provide a simplified theoretical expression for the rate of energy transfer into an explosive molecule,				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
without lengthy molecular dynamics or quantum chemical calculations. The approach combines both macroscopic thermodynamic properties and ultra fast spectroscopy data to study the initial nanosecond as the shock passes through the material. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2010 will focus on supporting Naval Battlespace Awareness and Intelligent naval Sensors, Innovative Naval Prototypes Initiative in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.					
HUMAN PERFORMANCE SCIENCES Efforts include: biosensors, biomaterial, bioprocesses; marine mammals; casualty care management, undersea medicine; human factors and organizational design; manpower, personnel and advanced cockpit; and operational training and education. These efforts are coordinated with the Navy Medical Research Center (NMRC). *FY 2008 Accomplishments:* - Continued research to elucidate the pathogenic mechanism, looking for common and different underlying mechanisms of injury, in hyperbaric oxygen and Blast OverPressure (BOP) induced injury by specific induction of heme oxygenase-1 or specific suppression of inducible nitric oxide synthesis in lungs. - Continued research to determine if inhaled heavy metals contribute to the pathogenesis of neurodegeneration. The research focused on the olfactory and trigeminal sensory nerves in the nasal mucosa. The hypothesis is that retrograde axonal transport of inhaled heavy metals from sensory nerves in the upper airway to the central nervous system results in significant neurotoxicity. - Continued research in the proliferation and differentiation of adult/stem progenitor cells to mature, terminally differentiated cells of skin, muscle, bone, nerve, heart, tendon, liver, and pancreas in a multi-step process. There is continual evidence that some tissue regenerative cells, particularly found in bone marrow migrate within the body and can contribute to healing at multiple sites in multiple lineages. Bone		2.019	1.998	2.192	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		FY 2008	FY 2009	FY 2010	FY 2011
marrow derived hematopoietic stem cells, mesenchymal stem cells, endothelial progenitor cells and skeletal muscle-derived stems can contribute to the regeneration of a variety of tissues in vivo. - Completed research to modify the test fixture to add a yaw capability, quantitatively determine the limits of human cervical spine tolerance to a parachute opening shock as a function of pitch and yaw to be representative of a true ejection environment. - Completed research experiments designed to prove the theory that adding spark arc conditions during the electro spin process that has tremendous impact on the chemistry of polymer formation and accurately describes the electro spinning phenomena. Understanding the fundamental science of electro spinning phenomena allows for intelligent approach – system engineering to the design of new formulation of nanotechnology based materials for military importance. - Completed the investigation of the degree to which periodic structures such as thin film holograms or photonic crystals are turned by ultra fast laser pulses. - Completed research to develop and demonstrate chemical and biological sensors based on the use of miniature array of Micro-Electro- Mechanical Systems (MEMS) based on the Frabry-Perot Interferometers (FPIs). The goals of the research effort is to yield very small, inexpensive arrayable devices capable of rapidly detecting a variety of Biological Warfare Agents (BWA) with low levels of false positives. - Initiated research in the area of understanding of vection (illusion of self-motion) in relation to contact. The goal of this research is identify the threshold for vection as a function of stimulus and understand when a pilot is susceptible to disorientation in critical environment (visual induced illusion of self-motion) conditions. - Initiated research to examine whether or not various forms of visuospatial attention are a manifestation of a single cognitive process. The intent of this research is to understand the basic principles of visuospatial attention would allow engineers to define upper and lower boundaries for attentional ability and design display systems to consider these aspects of operator performance. - Initiated research into exhaled nitric oxide measurement to provide a reliable and sensitive noninvasive marker of pulmonary oxygen toxicity in humans. The research seeks to measure normal day to day individual variability in pulmonary function and exhaled nitric oxidant and contrast these measurements with pulmonary function, exhaled nitric oxide and pulmonary oxygen toxicity symptoms.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2009 Plans: - Continue all efforts of FY 2008, less those noted as completed above. - Complete research to elucidate the pathogenic mechanism, looking for common and different underlying mechanisms of injury, in hyperbaric oxygen and BOP induced injury by specific induction of heme oxygenase-1 or specific suppression of inducible nitric oxide synthesis in lungs. - Complete research to determine if inhaled heavy metals contribute to the pathogenesis of neurodegeneration. The research focused on the olfactory and trigeminal sensory nerves in the nasal mucosa. The hypothesis is that retrograde axonal transport of inhaled heavy metals from sensory nerves in the upper airway to the central nervous system results in significant neurotoxicity. - Complete research in the proliferation and differentiation of adult/stem progenitor cells to mature, terminally differentiated cells of skin, muscle, bone, nerve, heart, tendon, liver, and pancreas in a multi-step process. There is continual evidence that some tissue regenerative cells, particularly found in bone marrow migrate within the body and can contribute to healing at multiple sites in multiple lineages. Bone marrow derived hematopoietic stem cells, mesenchymal stem cells, endothelial progenitor cells and skeletal muscle-derived stems can contribute to the regeneration of a variety of tissues in vivo. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. FY 2009 projects are currently going through a rigorous selection process at the naval warfare centers. Projects selected for FY 2009 will focus on supporting Naval Battlespace Awareness and Intelligent naval Sensors, Innovative Naval Prototypes Initiative in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete research in the area of understanding of vection (illusion of self-motion) in relation to contact. The goal of this research is identify the threshold for vection as a function of stimulus and understand when a pilot is susceptible to disorientation in critical environment (visually induced illusion of self-motion) conditions. - Complete researches to examine various forms of visuospatial attention are a manifestation of a single cognitive process. The goal of this research is to understand the basic principles of visuospatial attention				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
would allow engineers to define upper and lower boundaries for attentional ability and design display systems to consider these aspects of operator performance. - Complete the research in the area of exhaled nitric oxide measurements that provided a reliable and sensitive noninvasive marker of pulmonary oxygen toxicity in humans. The research seeks to measure normal day to day individual variability in pulmonary function and exhaled nitric oxidant and contrast these measurements with pulmonary function, exhaled nitric oxide and pulmonary oxygen toxicity symptoms. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2010 will focus on supporting Naval Battlespace Awareness and Intelligent naval Sensors, Innovative Naval Prototypes Initiative in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.					
INFORMATION SCIENCES		2.015	2.060	2.217	
Efforts include: mathematical foundation and computational theory and tools for design communications; decision support theory; algorithm and tools, information assurance, secure and reliable infrastructure for command and control; mathematical optimization for optimal resource allocation and usage; modeling and computational propagation; seamless, robust connectivity and networking and cyber warfare. *FY 2008 Accomplishments:* - Continued research to harness the power of clustering algorithms in association with other analytical techniques to detect changes in a system. Changes can be temporal, tracking a system over time or introduced in a system with outside influence. The research focused development of algorithms to compare different clustered data. Continued research to find and measure changes in data using data clustering as an underlying representation of the data. Experimental evaluation will be preformed utilizing our program to measure changes in the real data such as maritime domain data and synthetic data. - Continued research will focus on the development of nonlinear dynamics based criteria to distinguish structural damage from the general dynamic characteristic changes which will include environmental effects. The goal is to finalize the phased array interrogation/sensing, signal extraction and nonlinear					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
dynamic analysis scheme is effective, which is automatic to provide real-time health monitoring and diagnostic technology with potential for a variety of applications. - Completed the research in the area of generic types of streaming data with graphs. Streaming data is data that have a temporal relationship and arrived at such a rate (large volume) as to preclude past data from being revisited. Algorithms for streaming data make only one pass through the data and required use of data structures that enable information to be gained even though there is only limited memory and storage. Research issue on streaming data is import in today's world is collected faster than the data can be analyzed. - Completed research in the detection change and structures in the time series of graphs and networks. The purpose of this research was to detect and model significant changes in the graph, trends and anomalies in the time series of graphs. Investigated methods that are both informed applications and mathematical scientific issues. The project sought to determine applicability of social network analysis to networks of interest. - Initiated an investigation into the connection between graphs and commutative algebra, and construct fast algorithms to computer interesting new invariants on graph. This research project will link graph theory, commutative algebra, geometry and topology to provide new way to analyze data and information. - Initiated research into recent advances in Commercial Off The Shelf (COTS) microprocessor performance that have largely be achieved via added parallelism (adding additional microprocessor "cores" on the system), rather than by the more familiar method of increasing the clock speed. Research into developing software to perform well on these parallel architectures is difficult and expensive. The problem has been made more difficult by the vastly different programming techniques required by the two leading COTS parallel architectures (IBM "Cell BE" vs Intel/AMD x86). Initiate an investigation into a technique to automatically supply specialize Navy algorithm to these radically different architectures, and use a stochastic search to optimize the performance of the algorithm to each targeted architecture. - Initiated research to improve the methodology of time series summarization by utilizing the framework of second generation wavelets and on-off system models, and by inventing and utilizing better pre-processing strategies, segmentation algorithms, data transforms and dissimilarity functions. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete research to harness the power of clustering algorithms in association with other analytical techniques to detect changes in a system. Changes can be temporal, tracking a system over time or introduced in a system with outside influence. The research focused development of algorithms to compare different clustered data. Continued research to find and measure changes in data using data clustering as an underlying representation of the data. Experimental evaluation will be preformed utilizing our program to measure changes in the real data such as maritime domain data and synthetic data. - Complete research will focus on the development of nonlinear dynamics based criteria to distinguish structural damage from the general dynamic characteristic changes which will include environmental effects. The goal is to finalize the phased array interrogation/sensing, signal extraction and nonlinear dynamic analysis scheme is effective, which is automatic to provide real-time health monitoring and diagnostic technology with potential for a variety of applications. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. FY 2009 projects are currently going through a rigorous selection process at the naval warfare centers. Projects selected for FY 2009 will focus on supporting Naval Battlespace Awareness and Intelligent naval Sensors, Innovative Naval Prototypes Initiative in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete an investigation into the connection between graphs and commutative algebra, and construct fast algorithms to computer interesting new invariants on graph. This research project will link graph theory, commutative algebra, geometry and topology to provide new way to analyze data and information. - Complete research into recent advances in COTS microprocessor performance that have largely be achieved via added parallelism (adding additional microprocessor “cores” on the system), rather than by the more familiar method of increasing the clock speed. Research into developing software to perform well on these parallel architectures is difficult and expensive. The problem has been made more difficult by the vastly different programming techniques required by the two leading COTS parallel architectures (IBM “Cell BE” vs Intel/AMD x86). Initiate an investigation into a technique to automatically				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
supply specialize Navy algorithm to these radically different architectures, and use a stochastic search to optimize the performance of the algorithm to each targeted architecture. - Complete research to improve the methodology of time series summarization by utilizing the framework of second generation wavelets and on-off system models, and by inventing and utilizing better pre-processing strategies, segmentation algorithms, data transforms and dissimilarity functions. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2010 will focus on supporting Naval Battlespace Awareness and Intelligent naval Sensors, Innovative Naval Prototypes Initiative in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.					
NAVAL PLATFORM DESIGN SCIENCES Efforts include: novel hull forms, materials, structures and signatures; and virtual shaping concepts for structures and platforms *FY 2008 Accomplishments:* - Continued research in the increasing sophistication of sensor systems that have made mid- and high-frequency acoustic signature identification possible. New ship classes are given tight acoustic budgets, driving the exploration of new and novel concepts in hull form, materials and propulsion and development of structural and acoustic analysis tools to evaluate the vulnerability. The focus of this research project is to develop a method for efficiently addressing a class of mid-frequency vibration problems highly relevant to naval vessels. The goal is to capture directly the mid-frequency physics rather than apply a hybrid approach. - Continued research in the ThermoElectric (TE) devices used for waste heat recovery and its conversion to electrical energy. Conversion efficiencies of the TE devices are related to a dimensionless merit of figure referred to as ZT. Devices have low efficiencies to due to a low value of ZT. The goal of this research is to provide an improved understanding of the materials physical and chemical properties, that lead to an increase in the value of ZT and subsequently an increase in conversion efficiency. An		1.233	1.407	1.510	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
increase in value of ZT can be accomplished by reducing the lattice thermal conductivity and increasing the Seebeck coefficient and electrical conductive of TE materials. - Continued research to increase the energy density and lower the self-discharge rate of energy storage systems by identifying the physicochemical properties of the electrode/electrolyte interface associated with capacitance. Continued focus on novel carbons and lithium electrolytic salts (as opposed to tetraethylammonium tetrafluoroborate used in current capacitors) and non-aqueous, asymmetric hybrid supercapacitors. - Completed research to understand the influence of various metallurgical factors on the strengthening or softening mechanisms of Iron-based friction stir welds. The goal was to develop a predictive tool that is interchangeably correlate process parameters to mechanical property requirements for any material and thickness. - Completed research into a passive millimeter wave phenomenology in a maritime environment so that accurate signature models can be developed. Millimeter waves are defined as electromagnetic waves having wavelengths of 1 to 10 millimeters. - Completed research on the complex physical phenomena of aerodynamic heating on three-dimensional hypersonic bodies generated by the waverider concept. - Initiated research in the area of experimental breaking wave loads by bringing the analysis into the computational realm using the Reynolds Average Navier Strokes (RANS) codes. The research will investigate four general phases: creating consistent, repeatable breaking waves; creating these waves so that they break on the surface to analyze impact forces; validating those impact forces with existing and additional experimental data; and exploring the scaling effects of the impact forces. The goal of the research is to gain a much clearer understanding of the functional physics of breaking waves and the loads that are created, but to replicate these characteristics in a computational environment. The result of the computational capability will provide guidance for the future fleet designs and understand hydro loads on structural ship design. - Initiated research on a virtual shaping concept for structures and platforms. Virtual shaping is implemented by introducing a phase shift gradient in the reflective wave along a structural surface, which will cause the reflection of an incoming plane wave to be in a non-specular direction, minimizing the chance of detection by the emitter. The virtual shaping concept could be implemented by surface treatments, appliqués containing micropatch arrays, constructed to simulate the effects of shaping when				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
applied to the ship structure. This goal of this research are to reduced the need for tumblehome design for stealthiness, reduced surface area of topside structures and retrofitting of existing ships to reduce their radar cross section - Initiated research to develop the next generation prediction tools based on RANS such that arbitrary complex geometries including non-circular body can be handled and the reliance on empiricism can be minimized. The goal of this research is to be accurate and fast enough to do real time analysis and support submarine design and be able to accommodate submarine Submerged Operating Envelope (SOE). *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Complete research on the increasing sophistication of sensor systems that have made mid- and high-frequency acoustic signature identification possible. New ship classes are given tight acoustic budgets, driving the exploration of new and novel concepts in hull form, materials and propulsion and development of structural and acoustic analysis tools to evaluate the vulnerability. The focus of this research project is to develop a method for efficiently addressing a class of mid-frequency vibration problems highly relevant to naval vessels. The goal is to capture directly the mid-frequency physics rather than apply a hybrid approach. - Complete research in the TE devices used for waste heat recovery and its conversion to electrical energy. Conversion efficiencies of the TE devices are related to a dimensionless merit of figure referred to as ZT. Devices have low efficiencies to due to a low value of ZT. The goal of this research is to provide an improved understanding of the materials physical and chemical properties, that lead to an increase in the value of ZT and subsequently an increase in conversion efficiency. An increase in value of ZT can be accomplished by reducing the lattice thermal conductivity and increasing the Seebeck coefficient and electrical conductive of TE materials. - Complete research to increase the energy density and lower the self-discharge rate of energy storage systems by identifying the physicochemical properties of the electrode/electrolyte interface associated with capacitance. Continued focus on novel carbons and lithium electrolytic salts (as opposed to tetraethylammonium tetrafluoroborate used in current capacitors) and non-aqueous, asymmetric hybrid supercapacitors.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. FY 2009 projects are currently going through a rigorous selection process at the naval warfare centers. Projects selected for FY 2009 will focus on supporting Naval Battlespace Awareness and Intelligent naval Sensors, Innovative Naval Prototypes Initiative in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete research on breaking wave loads utilizing the computational RANS codes. The research will investigate four general phases: creating consistent, repeatable breaking waves; creating these waves so that they break on the surface to analyze impact forces; validating those impact forces with existing and additional experimental data; and exploring the scaling effects of the impact forces. The goal of the research is to gain a much clearer understanding of the functional physics of breaking waves and the loads that are created, but to replicate these characteristics in a computational environment. The result of the computational capability will provide guidance for the future fleet designs and understand hydro loads on structural ship design. - Complete research on a virtual shaping concept for structures and platforms. Virtual shaping is implemented by introducing a phase shift gradient in the reflective wave along a structural surface, which will cause the reflection of an incoming plane wave to be in a non-specular direction, minimizing the chance of detection by the emitter. The virtual shaping concept could be implemented by surface treatments, appliqués containing micropatch arrays, constructed to simulate the effects of shaping when applied to the ship structure. This goal of this research are to reduced the need for tumblehome design for stealthiness, reduced surface area of topside structures and retrofitting of existing ships to reduce their radar cross section - Complete research to develop the next generation prediction tools based on RANS such that arbitrary complex geometries including non-circular body can be handled and the reliance on empiricism can be minimized. The goal of this research is to be accurate and fast enough to do real time analysis and support submarine design and be able to accommodate submarine SOE.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2010 will focus on supporting Naval Battlespace Awareness and Intelligent naval Sensors, Innovative Naval Prototypes Initiative in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.					
OCEAN/SPACE SCIENCES Efforts include: Littoral Geosciences, Optics, and biology; Marine Mammals; Ocean Acoustics; and autonomous systems. *FY 2008 Accomplishments:* - Continued research and development of test algorithms for acoustics marine mammal (Beaked Whales) bioacoustics and spatial/temporal habitat characterization in the Tongue of the Ocean, Bahamas. Density estimation algorithms were developed and three methods were investigated: group localization, time-difference-of-arrival histograms, and click counting. Counting beaked whale vocalization termed clicks was shown to be a promising technique to measure the beaked whale population density on the Atlantic Undersea Test and Evaluation Center (AUTEC) Range. Beaked whales appear to be the most susceptible to active sonar. Research is continuing to determine whether this technique can be used on ranges in other environments. - Continued Naval Research Enterprise Intern Program (NREIP) to support undergraduate and graduate students performing navy-related research at Naval Warfare Centers under the supervision and mentorship of DON Scientists, thus exposing them to interesting and challenging work done at the centers. NREIP is a continuing navy education program. - Continued research to determine whether chaos based communications can be applied to typical range tracking scenarios. Chaos based spread-spectrum communications to underwater telemetry have been explored, simulated and demonstrated for low-Doppler littoral environments. Initial analysis of in-water experiments including determining the suitability of chaotic sequences for detection and time-stamping when tracking was performed.		4.289	4.702	4.610	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Completed the analytical solution to the vector wave equation in prolate Spheroidal which developed a lossy material. The results of this research will enable rapid and complete prediction of sonar array performance for submarines. - Completed the research to develop methods to automatically segment and characterize data using Bayesian networks. Developed hierarchical texture segmentation algorithms based on tree-structured Bayesian networks (TSBN) and Dynamic Tree (DT) graphical image models. - Completed the application of level sets to the problem of acoustic propagation in shallow water regimes, providing robust theoretical and numerical foundation for accurate range dependent acoustic modeling. This effort will provide greater flexibility and improved accuracy in the simulation of propagation in the littoral environment. - Initiated research in the development of a pentacene based neutron detector. This effort will seek to explore processing parameters for preparing thick pentacene-based films at purities suitable for neutron detection and develop a fundamental understanding of electronic structure interaction of pentacene with organo-boron-containing film components. - Initiated investigation of the phenomenon of Core-Valence Luminescence (CVL) in scintillators that have the potential of radiation discrimination. CVL is the emission resulting from radiative transitions between the valance and first core band under gamma excitation. The effort will explore unique spectral properties which can be exploited to discriminate between different types of nuclear radiation. - Initiated research into the relative performance of promising technologies (Probabilistic Multi-Hypothesis Tracker (PMHT) and Joint Probabilistic Data Association (JPDA)) and methods for integrating the best aspects of both into a single multi-target tracking and data fusion algorithm. This effort will seek to integrate an Interacting Multiple Model (IMM) algorithm into the PMHT algorithm, with a Multi-Dimensional Assignment (MDA). - Initiated research and development into a new scaleable Computational Fluid Dynamics (CFD) tool to simulate the propulsion and maneuvering hydrodynamics of biominetic Autonomous Underwater Vehicles (AUV) employing multiple flapping foils as the primary propulsor and control surfaces. This research effort is to demonstrate that CFD can be an effective tool for evaluating biominetic AUV designs and development of control strategies for optimizing the hydrodynamic performance of biomimetic designs and minimizing undesirable effects such as unwanted vehicle motions that can degrade sensor performance.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2009 Plans: - Continue all efforts of FY 2008, less those noted as completed above. - Complete the beaked whale algorithms for density data is to be analyzed for spatial, seasonal and diurnal trends, and the relationships to oceanographic features. Detection and localization archive files from a number of marine mammal monitoring on Navy ranges at the Atlantic Undersea Test and Evaluation Center, Bahamas. The results of the algorithms are required to meet proposed mitigation measures for both at sea operations and long term monitoring of the Navy's undersea acoustic ranges. - Complete the chaos based spread-spectrum communications to underwater telemetry have been explored, simulated and demonstrated for low-doppler littoral environments. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. FY 2009 projects are currently going through a rigorous selection process at the naval warfare centers. Projects selected for FY 2009 will focus on supporting Naval Battlespace Awareness, Innovation Naval Prototypes Initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility Initiatives in Ocean Acoustics and Undersea Weaponry. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete research in the development of a pentacene based neutron detector. This effort will seek to explore processing parameters for preparing thick pentacene-based films at purities suitable for neutron detection and develop a fundamental understanding of electronic structure interaction of pentacene with organo-boron-containing film components. - Complete investigation of the phenomenon of CVL in scintillators that have the potential of radiation discrimination. CVL is the emission resulting from radiative transitions between the valance and first core band under gamma excitation. The effort will explore unique spectral properties which can be exploited to discriminate between different types of nuclear radiation. - Complete research into the relative performance of promising technologies (PMHT and JPDA) and methods for integrating the best aspects of both into a single multi-target tracking and data fusion algorithm. This effort will seek to integrate an IMM algorithm into the PMHT algorithm, with a MDA.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete research and development into a new scaleable CFD tool to simulate the propulsion and maneuvering hydrodynamics of biominetic AUV employing multiple flapping foils as the primary propulsor and control surfaces. This research effort is to demonstrate that CFD can be an effective tool for evaluating biominetic AUV designs and development of control strategies for optimizing the hydrodynamic performance of biomimetic designs and minimizing undesirable effects such as unwanted vehicle motions that can degrade sensor performance. - Initiate ILIR projects that are intended to be approximately three years in length. Based on historical trends approximately 30% of ILIR projects will turn over each year. Projects selected for FY 2010 will focus on supporting Naval Battlespace Awareness, Innovation Naval Prototypes Initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility Initiatives in Ocean Acoustics and Undersea Weaponry.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601101A/In-House Laboratory Independent Research									Continuing	Continuing
PE 0601102F/Defense Research Sciences									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

The ILIR initiative seeks to improve the quality of defense research conducted predominantly through the Naval Warfare Centers/Laboratories. It also supports the development of technical intellect and education of engineers and scientists in disciplines critical to national defense needs through the development of new knowledge in a military laboratory environment. Initial research focus is often conducted in an unfettered environment since it is basic research, but many projects focus on

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601152N IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	PROJECT NUMBER 0000

applying recently developed theoretical knowledge to real world military problems with the intention of developing new capabilities and improving the performance of existing systems. Individual project metrics then become more tailored to the needs of specific applied research and advanced development programs. The National Research Council of the National Academies of Science and Engineering's Congressionally directed "Assessment of Department of Defense Basic Research" concluded that the DoD is managing its basic research program effectively.

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research					R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES					
COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
Total Program Element	377.396	419.939	413.743						Continuing	Continuing
0000: DEFENSE RESEARCH SCIENCES	377.396	419.939	413.743						Continuing	Continuing

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. It is based on investment directions as defined in the Naval Science & Technology Strategy approved by the S&T Corporate Board (Jan 2007). This new strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It exploits scientific breakthroughs and provides options for new Future Naval Capabilities (FNCs) and Innovative Naval Prototypes (INPs).

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 on the order of a hundred technology and capability-related 'thrusts', which are consolidated into about fifteen research areas. These in turn support the major research areas of the Navy and Marine Corps: Autonomous Systems; Command, Control, Communications and Computers (C4); Countermeasures and Counterweapons; Marine as a System; Information Analysis and Decision Support; Intelligence, Surveillance and Reconnaissance; Logistics; Materials; Operational Environments; Platforms; Power and Energy Technology; Sensors and Electronics; Warrior Performance and Protection; Weapons and Support (Education and Outreach).

S&T investment in basic research also includes the National Naval Responsibilities (NNRs), fields upon which a wide range of fundamental Naval capabilities depend. There are currently four NNRs.

S&T investment in basic research also includes the Basic Research Challenge program which was established to competitively select and fund promising research programs in new areas not addressed by the current basic research program. The Basic Research Challenge Program stimulates new, high-risk basic research projects in multi-disciplinary and departmental collaborative efforts, and funds topics that foster leading edge science and attract new principal investigators and organizations. Basic Research Challenge awards are for a period of four years.

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

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	**R-1 ITEM NOMENCLATURE** PE 0601153N DEFENSE RESEARCH SCIENCES

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	383.217	407.271	423.633	
Current BES/President's Budget	377.396	419.939	413.743	
Total Adjustments	-5.821	12.668	-9.890	
Congressional Program Reductions		-6.168		
Congressional Rescissions				
Total Congressional Increases		18.900		
Total Reprogrammings	-3.796			
SBIR/STTR Transfer	-2.025			
Program Adjustments			-7.233	
Rate/Misc Adjustments		-0.064	-2.657	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **BIOCHEMICAL AGENT DETECTION**	0.772	0.798
Project: 9999, **CENTER QUANTUM STUDIES**	0.000	1.197
Project: 9999, **ENERGETICS S&T WORKFORCE DEVELOPMENT**	2.321	4.488
Project: 9999, **EVALUATING ELF SIGNALS IN MARITIME ENVIRONMENTS**	1.543	1.596
Project: 9999, **MOBILE AD HOC DATA COMMUNICATIONS FOR UNMANNED SYSTEMS**	0.772	0.000
Project: 9999, **NAVY SCIENCE AND TECHNOLOGY OUTREACH (N-STAR) MARYLAND**	0.795	0.997
Project: 9999, **ONAMI NANOELECTRONICS AND NANOMETROLOGY INITIATIVE**	1.929	3.989
Project: 9999, **RESEARCH SUPPORT FOR NANOSCALE RESEARCH FACILITY**	0.000	2.792
Project: 9999, **ROTATIONAL MOLDED DOUBLE WALL FOR UN-MANNED PATROL BOAT**	2.913	0.000
Project: 9999, **TEXAS MICROFACTORY**	3.374	2.992

Change Summary Explanation

Technical: As directed by the Secretary of Defense, an increase from FY 2008 to FY 2009 for Basic Research (6.1) to fund peer-reviewed research to develop innovative solutions and enhance the science and engineering base. The increase also includes the Basic Research Challenge which is a competitive investment based on proposed scientific activities.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES					PROJECT NUMBER 0000	
COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
0000: DEFENSE RESEARCH SCIENCES	377.396	419.939	413.743						Continuing	Continuing

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. It is based on investment directions as defined in the Naval Science & Technology Strategy. This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It exploits scientific breakthroughs and provides options for new Future Naval Capabilities (FNCs) and Innovative Naval Prototypes (INPs).

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 on the order of a hundred technology and capability-related 'thrusts', which are consolidated into about fifteen research areas. These in turn support the major research areas of the Navy and Marine Corps: Autonomous Systems; Command, Control, Communications and Computers (C4); Countermeasures and Counterweapons; Marine as a System; Information Analysis and Decision Support; Intelligence, Surveillance and Reconnaissance; Logistics; Materials; Operational Environments; Platforms; Power and Energy Technology; Sensors and Electronics; Warrior Performance and Protection; Weapons and Support (Education and Outreach).

S&T investment in basic research also includes the National Naval Responsibilities (NNRs), fields upon which a wide range of fundamental Naval capabilities depend. There are currently four NNRs.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
AIR, GROUND AND SEA VEHICLES	44.133	51.856	54.261	
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				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

Combat Air Vehicle (UAV/UCAV); environmental quality; logistics; and power generation, energy conversion, and storage.

As directed by the Secretary of Defense, this activity reflects an increase from FY 2008 to FY 2009 for Basic Research (6.1) to fund peer-reviewed research to develop innovative solutions and enhance the science and engineering base. The increase also includes the Basic Research Challenge which is a competitive investment based on proposed scientific activities.

FY 2008 Accomplishments:

Air Vehicles

- Continued investigations into controlled initiation and recovery from aggressive non-linear aero-maneuvers conducted by unmanned air vehicles.
- Continued university research in rotorcraft technology areas such as tilt rotor aeromechanics, rotor flow field/ship air wake coupling during shipboard operations, flight simulation of advanced ducted fan air vehicles, active rotor control for enhanced ship board operations, autonomous rotorcraft operations in shipboard environment, and innovative rotor design concepts for naval applications.
- Continued research in computational simulation of rotorcraft operations in shipboard environment.
- Continued investigation of advanced structural concepts providing a high degree of crew protection during crashes.

Ship Concepts and Hydrodynamics

- Continued 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.
- Continued implementation of nationwide program to increase interest in naval engineering education.
- Continued the Research Tools Development Consortia Program under the University Research – Engineering Design Consortia.
- Continued further examination of computational mechanics to address prediction of acoustic signatures in complex structures, modeling of structural failures and optimization, sensitivity analysis and error control.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued propeller tip vortex cavitation and sheet-to-cloud cavitation. - Completed experiments for rough-wall boundary layer noise. - Completed modeling of multi-phase flow. - Completed potential-flow modeling of waterjet propeller cavitation. - Completed Reynolds Average Navier Strokes (RANS) predictions of surface ship motion for high speeds. - Completed validation of prediction of ship wave breaking and bubbly flow at full scale. - Initiated computational and experimental investigation into complex three-dimensional flow separation problems. - Initiated measurement and modeling of small wave effects on wave breaking and bubble generation. - Initiated modeling and understanding of full-scale circulation control bow planes design. Ship Signatures, Structures, and Materials - Continued the structural performance of hybrid ship hulls and hybrid joints subject to sea loads and weapons effects for application to high speed, low signature vessels. - Continued modeling of alternating current sources and propagation. - Continued Particle Image Velocimetry (PIV)/Laser Doppler Velocimetry (LDV) studies of multiphase bubble flows and interaction with elastic plates in a small quiet water tunnel. - Continued LDV of scaling effects studies of unsteady elastic duct and propulsor interaction in a wind tunnel. - Continued effort on much higher strain rate loading and constitutive behavior of Explosion Resistant Coating (ERC) for strain rates appropriate to ballistic events. - Continued work on cohesive elements for dynamic fracture under combined mode for application to failure in joints in ship structures under blast loading. - Continued work on hybrid ship (no-magnetic stainless steel/composite) hull concepts. - Continued 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. - Continued concept for photonic band gap waveguide.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued methods to model the mechanisms of interaction between an elastic duct wall and fluid-flow in a duct with a propeller. - Continued development of advanced multispectral InfraRed (IR) materials. - Continued development of computational mechanics to provide predictive capabilities of acoustics, linear and nonlinear dynamic response and failure mechanisms of structures. - Continued development of mmWave material characterization system. - Continued efforts in alternative hull for fast ships and hybrid ship hull structures - Continued efforts in understanding of explosion resistant coating under extreme loads and its interaction with other armor and structural materials. - Completed study to extend near-field acoustic holography measurement techniques to large-scale measurements in cluttered noisy environments. - Completed studies of the structural acoustics of anisotropic propulsion ducts. - Initiated investigation into methods to control airborne noise transmission using active control. - Initiated development of metamaterial concepts for radio frequency (RF) signature control and photonic and acoustic applications. - Initiated experimental facility for sea-slamming loads in fast ships, and considering hydro-elasticity and structural details in composites panels and scale effects. Measurements are used developing new theoretical models. Ship and Air Platform Machinery and Systems - Continued efforts to understand and control the generation and propagation of far-field jet noise. - Continued development of Pulsed Detonation Engine (PDE) Technology. - Continued development and understanding of control capabilities and distributed intelligence strategies for shipboard systems. - Continued propulsion system cost-reduction efforts through reduction of vibration, noise and thermal fluctuation at the source by controlling combustion. - Continued passive and active high speed noise control. - Continued studies of alternate propulsion systems for PDE and generate prediction models. - Continued investigation of thermal management approaches for cooling high power electronic devices. - Continued research on non-vapor compression based refrigeration cycles.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

Power Generation, Energy Conversion and Storage
- Continued evaluation of stability and control of electrical power systems.
- Continued analyzing synchronization of 19 diode lasers to produce intense beams.
- Continued efforts in nanostructures, novel electrolytes, and electrode materials to enable new 3D power source architectures to improve capacity of rechargeable lithium and lithium-ion batteries.
- Continued exploration and development of materials for high energy density passive power electronics (Capacitors).
- Continued expanding the fundamental understanding of direct electrochemical oxidation and the use of logistic fuels in solid oxide fuel cells.
- Continued research into new functional materials and new concepts to efficiently convert thermal, photonic, or vibrational energy to electric energy from primary or secondary sources.
- Continued research tools design efforts in Chemical Dynamics and High Temperature Probes.
- Continued development of phase change cooling approaches for high power electronic devices.
- Continued development of multi-scale thermal modeling approaches.
- Continued efforts developing science base for optimized combustion of alternative fuels.
- Continued research on the scientific basis of nanostructure enhancement of semiconductor and functional materials performance for power generation and thermal management.

FY 2009 Plans:
Air Vehicles
- Continue all efforts of FY 2008.

Ship Concepts and Hydrodynamics
- Continue all efforts of FY 2008, less those noted as completed above.
- Complete measurement and modeling of small wave effects on wave breaking and bubble generation.
- Initiate validation of Unsteady Reynolds Averaged Navier Strokes (URANS) prediction on maneuvering effects on ship motion in waves.
- Initiate modeling of hydroacoustics of advanced materials propulsor.
- Initiate program to investigate renewable energy technologies for navy applications.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate computational and experimental investigations of wakes in stratified fluids. - Initiate Large Eddy Simulation (LES) modeling of crashback of underwater vehicle with propulsor. Ship Signatures, Structures, and Materials - Continue all efforts of FY 2008, less those noted as completed above. - Complete methods to model the mechanisms of interaction between and elastic duct wall and fluid flow in a duct with a propeller. - Complete PIV/LDV studies of multiphase bubble flows and interaction with elastic plates in a small quiet water tunnel. - Initiate study of droplet & volume scattering phenomena. - Initiate the development of predictive models for infrared emission and reflection from breaking waves. - Initiate development of computational electromagnetic (CEM) tools for electromagnetic materials design & optimization. - Initiate development of a methodology for highly reliable composite to metallic joints. - Initiate fundamental efforts in multi-scale, time-varying, hull structural reliability models and processes for structural performance analysis. - Initiate basic research challenge on "Elastomeric Polymer-by-Design to Protect the Warfighter Against Traumatic Brain Injury by Diverting the Blast Induced Shock Waves From the Head". Ship and Air Platform Machinery and Systems - Continue all efforts of FY 2008. - Initiate studies of advanced air-breathing propulsion concepts. - Initiate study of advanced materials for Pulsed Detonation Engine (PDE) Applications. - Initiate efforts to expand the model based reasoning control algorithm approach to multiple heterogeneous systems. - Initiate studies of complexity in heterogeneous distributed control systems. - Initiate efforts to investigate a market based control approach to distributed control. - Initiate efforts to perform physics based modeling of fluid actuation systems. Power Generation, Energy Conversion and Storage					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continue all efforts of FY 2008. - Complete development of multi-scale thermal modeling approaches. - Complete research tools design efforts in Chemical Dynamics and High Temperature Probes. - Initiate the investigation of the long-term durability effects of coating/substrate systems from combustion chemistries and products derived from current petroleum-based fuel and from petroleum-based/synthetic fuel blends that lead to predictive models. - Initiate effort in energy and power management to include understanding and reliability of high power electronics. *FY 2010 Plans:* Air Vehicles - Continue all efforts of FY 2009. - Initiate research into new analytical methods for high-fidelity prediction of rotorcraft performance, loads, and vibration. - Initiate university and Navy Lab research in basic rotorcraft science with emphasis on enabling concepts for variable geometry/variable rotor-speed aircraft. Ship Concepts and Hydrodynamics - Continue all efforts of FY 2009, less those noted as completed above. - Complete the Research Tools Development Consortia Program. - Initiate measurement and modeling of unsteady high-speed craft hydrodynamics. - Initiate high-fidelity fluid-structure interaction program. Ship Signatures, Structures, and Materials - Continue all efforts of FY 2009, less those noted as completed above. - Complete development of photonic crystal waveguide and radiating systems. - Initiate the development and understanding of elastomeric polymers for multi functionality in protection systems/armor and structural acoustics with superior properties against environmental effects and extreme temperature.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Ship and Air Platform Machinery and Systems - Continue all efforts of FY 2009. Power Generation, Energy Conversion and Storage - Continue all efforts of FY 2009, less those noted as completed above.					
ATMOSPHERE AND SPACE SCIENCES Efforts include: Marine Meteorology and Prediction and Space Sciences. Beginning in FY 2009, this activity includes the Basic Research Challenge which is a competitive investment based on proposed scientific activities. Accomplishments and plans described below are examples for each effort category. The increase in funding in FY 2009 and out reflects an increased emphasis in marine meteorology. *FY 2008 Accomplishments:* Marine Meteorology and Prediction - Continued analysis of results from major field projects on air-sea interaction and transition improvements into applied research to improve the treatment of fluxes in coupled atmosphere-ocean prediction systems. - Continued the development of next-generation ocean-atmosphere coupled models. - Continued effort to investigate and better understand the bulk exchanges, aerosol-cloud interaction, and physical processes that take place at the atmospheric boundary layer interface. - Continued theoretical and observational effort to improve understanding of the fundamental dynamics of mountain waves, including generation, propagation, nonlinear interaction, and wave breaking. - Continued effort to gain a fundamental understanding of the flow-dependent limits of predictability by combining research in data assimilation and atmospheric instability. - Continued investigation into the near-earth environmental effects on electromagnetic propagation. - Continued investigation of sub-grid-scale processes that influence marine boundary layer turbulence, aerosol production and removal, and marine stratocumulus cloud and drizzle formation and dissipation with the goal of improving the predictability of these phenomena in high-resolution mesoscale prediction systems.		22.804	25.247	28.320	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued investigation of Western Pacific tropical cyclone dynamics in order to improve the predictability of storm genesis, structure and intensity changes, radii of maximum winds and effects on sea surface waves. - Continued investigation of the effects of radioactively important aerosols on cloud dynamics and thermal structure of the lower atmosphere for the purpose of improving the treatment of these processes in numerical weather prediction models. - Continued effort to assimilate WindSat wind vector, Ozone Mapping and Profiler Suite (OMPS) ozone profiles, and Global Positioning System (GPS) temperature and water vapor profile retrievals into NOGAPS (Navy Operational Prediction System). - Continued effort to derive sea foam coverage from WindSat and to use this information in microphysical aerosol models to derive marine optical properties. - Continued assessment of the status of aerosol observation, prediction, and understanding for use in slant-range visibility and electro-optical performance prediction models. - Continued development of new soil moisture retrieval algorithm that addresses the basic modeling issues pertinent to soil moisture retrieval using passive microwave data from the NRL WindSat instrument. - Continued demonstration and validated a new data assimilation capability in NOGAPS ALPHA to generate the first global atmospheric analysis fields that extend from the ground to the edge of space. Space Sciences - Continued effort to exploit the polarametric aspect of WindSat for non-ocean surface wind vector Meteorological and Oceanographic Command (METOC) retrievals. Effort this year focused on soil moisture and sea ice. - Continued the development of 3D magnetohydrodynamic code for simulations of solar filament eruptions leading to flare and coronal mass ejection (CME) activity. - Continued studies of the major October-November 2003 solar activity events and the associated effects on the near-Earth space environment. - Continued effort to improve understanding of tropospheric and stratospheric bulk exchanges through observations and modeling. Effort this year focused on finding individual thunderstorm cells spawned by forest fires (pyrocumulonimbus clouds) which have injected material into the stratosphere.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued assessment of advanced techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography. - Continued program to develop advanced improvements to specification and prediction of the space environment to improve space system performance and their on-call availability. - Continued 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. - Continued a focused program to develop a predictive, operational capability for the onset and evolution of equatorial spread-F that limits space-based communications and navigation capabilities. - Continued a program to use large high frequency/very high frequency (HF/VHF) arrays to investigate fine scale ionospheric phenomena with associated improvements in ionospheric modeling and the performance of current and future DoD capabilities impacted by ionospheric disturbances. - Completed calibration/validation of meteorological satellite wind (WindSat) polarimetric passive microwave data, and developed the version 1 of the WindSat wind vector retrieval algorithm. WindSat wind vectors have been released to the science community for evaluation. - Completed development and evaluation of techniques for remote sensing of upper atmosphere phenomena including neutral density, winds and bulk exchange cycles. - Initiated program to extend magnetohydrodynamic models of solar activity, and related effects on the near-Earth space environment, toward an improved predictive capability on communication and navigation systems, and other related effects on DoD operations. - Initiated effort to develop better physical understanding of small-scale atmospheric wave dynamics in the middle and upper atmosphere. - Initiated effort to develop understanding of how multi-scale interactions impact the predictability of tropical cyclones and their downstream effects. - Initiated effort to develop understanding to forecast the sun’s changing extreme ultraviolet (EUV) radiation and the responses of the upper atmosphere and ionosphere one-to-ten days in advance. - Initiated effort to develop and validate numerical models of high-energy solar energetic particle (SEP) and solar gamma-ray (SGR) emissions.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

- Initiated effort to develop a quantitative standard model for solar flares that satisfies UV-X-ray observations; understand the origin, dynamics, and evolution of plasma in active region magnetic flux tubes.

FY 2009 Plans:

Marine Meteorology and Prediction

- Continue all efforts of FY 2008, less those noted as completed above.
- Initiate effort to derive and test advanced nonlinear atmospheric data assimilation algorithms using variational and ensemble techniques that are firmly based on modern inverse problem theory.
- Initiate effort to understand the fundamental physics and dynamics that control cloud and aerosol variability in the marine boundary layer.

Space Sciences

- Continue all efforts of FY 2008, less those noted as completed above.
- Initiate effort to develop the basis for an observational technique potentially enabling the first physics-based prediction of the severity of the largest energetic particle events generated by the Sun.
- Initiate investigation in the feasibility of using Thompson scattering to directly and globally image the near-Earth electron density distributions and their variations driven by the solar wind to enable space environment forecasting and comprehensive space domain awareness for the Navy and DoD.
- Initiate investigation of the driving mechanisms, mode characteristics, and impact on space plasmas of electromagnetic waves relevant to radiation belt remediation and auroral ionospheric space weather.
- Initiate research on advanced EUV/X-ray optics and associated spectral modeling and data analysis, to improve the precision of solar irradiance monitoring and enable accurate irradiance forecasts.

FY 2010 Plans:

Marine Meteorology and Prediction

- Continue all efforts of FY 2009.
- Complete analysis of results from major field projects on air-sea interaction and transition improvements into applied research to improve the treatment of fluxes in coupled atmosphere-ocean prediction systems.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Complete theoretical and observational effort to improve understanding of the fundamental dynamics of mountain waves, including generation, propagation, nonlinear interaction, and wave breaking. - Complete assessment of the status of aerosol observation, prediction, and understanding for use in slant-range visibility and electro-optical performance prediction models. - Initiate field project to increase understanding of air-sea exchange of enthalpy (heat and moisture) to improve high-resolution coupled atmosphere-wave-ocean TC prediction systems. Space Sciences - Continue all efforts of 2009. - Initiate effort to assemble individual databases and model components of the Sun-Earth System.					
COUNTER IMPROVISED EXPLOSIVE DEVICE (IED) SCIENCES		23.878	23.229	22.323	
The ONR Basic Research Counter IED program seeks to develop innovative scientific concepts that will form the foundation for future technologies that may be developed and implemented to efficiently and effectively address the IED threat. The effort will emphasize fundamental scientific concepts that can be applied to the detection, neutralization, destruction and mitigation of the effects of these devices and to advance prediction of the occurrence or potential occurrence of IED events. The program also seeks to establish and nurture a multi-disciplinary counter-IED Science and Technology community of Government, academic and industry researchers to accelerate the transition of new science and technology into fielded systems. This activity also includes Secretary of Defense directed peer-review basic research to develop innovative solutions and enhance the science and engineering base. *FY 2008 Accomplishments:* - Continued effort in the area of Prediction to develop theoretical and technical approaches that permit prediction and analysis of IED emplacement as well as the assembly of IEDs. This included recognition of emplacement patterns, human activity recognition from video and other sensing systems, human intelligence and social network analysis of terrorist networks, modeling and simulation of the full spectrum					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
of IED activities, analysis of communications, and knowledge management systems to combine diverse data sources. - Continued effort in the area of Detection to develop concepts that would permit stand-off detection and localization of the explosive, the case materials, the environment in which the device is located, and other components of the IED. - Continued effort in the area of Neutralization to develop scientific concepts that may be applied to remotely render an IED ineffective without necessarily having to detect or destroy it. - Continued effort in the area of Destruction to develop scientific concepts that may be applied to quickly and remotely destroy IEDs without necessarily having to detect them. - Continued effort in the area of Mitigation to develop scientific concepts that may be applied to protect people and/or equipment from the destructive effects of an IED that may be detonated. - Continued computational fluid dynamics (CFD) CT-Analyst technology that provides a sensitive operational-quality capability to backtrack airborne detections of the chemical signatures and taggants of explosives instantly to their source. - Continued reactive flow dynamics study of multiphase reactive flow modeling and simulation that can be applied to investigate mitigation strategies to counter the IED threat. - Continued flame suppression mechanism investigation of additives to fine water mist to provide the scientific basis to guide search for suitable fine water mist based fire suppression strategies for DoD platforms, and to mitigate explosive blast effects. - Continued investigating neutron-sensitive glass materials for remote radiation sensing to develop novel approaches for detection of radiological threats: special nuclear materials, dirty bombs, IEDs. - Continued the study of molecular motions & physical properties under stress to develop better elastomers for applications of flexible materials (blast resistant coatings, sonar domes, appliqués). - Continued investigation and development of nonlinear methods to more effectively describe and analyze hyperspectral and multi-sensor data to improve characterization using nonlinear (manifold) methods. - Continued study of metal nanoparticles for insensitive munitions (IM) with high energy density and low sensitivity to hazardous conditions, operational environment and countermeasures. - Continued development of rapid identification of biological aerosols, a novel method that allows specific biological aerosols to be identified within a background of others and that can fulfill the criteria of continuous sampling, real time performance, use of a small amount of consumables, and portability.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued a systems biology approach for the interrogation of marine microorganisms to describe and predict the functioning of an entire marine bacterial system in response to certain stimuli which will provide the ability to comprehensively model and manipulate microbiological systems for the development of next generation sensors for biological, chemical and explosive agent detection. - Continued synthetic nanopores for single molecule identification to demonstrate a novel synthetic-nanopore-based strategy for real-time, label-free, single molecule detection of chemical and biological threats. - Completed laboratory-on-a-chip studies of molecular dynamics and recognition including complex, integrated separations performed on a rapid timescale for DoD target analytes such as toxic industrial chemicals and chemical warfare agents which may be used in IEDs. - Completed studies of the fundamental issues in processing of quartz-crystal microbalance arrays directed to making micro-arrays of quartz crystals, each working at different frequencies. - Completed the study of radar for active detection of suicide bombers. - Completed activities to devise and demonstrate chemical templates for assembling/positioning nanoclusters and nanowire leads with nanometer precision to better understand the chemical & biochemical assembly of nanocluster-based electronics/sensors. Investigated ultra-fine electroless deposition for forming electrical leads. Explored early applications to single-electron devices and high-sensitivity sensors. - Completed exploration into advanced microarchitectures for bioprocessing and sensing to develop and characterize cellular microarrays expressing G-protein coupled receptors (GPCRs) and other proteins as targets for environmental detection. - Initiated creation of new spectroscopy for sensitive characterization of semiconductor nanostructures, ultra-thin molecular films and chemical/biological threat materials and explosives. - Initiated development of high-power mid-Infrared (IR) lasers for IR countermeasures, explosives detection (ED), biological detection, remote chemical sensing, etc. - Initiated development of product that will provide the warfighter protection against blast pressure wave and complements efforts in ballistic/projectile protection and combat casualty care communities. - Initiated development of a new chemical explosive detection concept based on pump/probe ultrashortpulse lasers.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated effort to develop a chemically strengthened visible infrared (Vis-IR) composite window made from Spinel ceramic and germanate glass. - Initiated research on characterizing background noise in urban and riverine environments in support of IED signature detection. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Initiate a Counter-IED Grand Challenge effort to pursue innovative device neutralization modalities, augmented by device detection technologies. - Initiate development of nonlinear methods to significantly improve the differentiation of targets from background scenes in multivariate data sets of hyperspectral imagery. - Initiate development of high performance polymer materials for armor applications - Initiate effort to directly observe lattice deformations in explosives under shock impact. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Initiate analytical study to detect an intruder in proximity to an underwater pipeline using structure-guided acoustic waves. - Initiate increased emphasis on sociological and cultural aspects of defeating insurgent networks. - Initiate increased emphasis on standoff wide area neutralization and pre-detonation of IEDs. - Initiate increased emphasis on stronger lightweight armor including nanoparticle designs. - Initiate increased emphasis on detection of physical and temporal device characteristics.				
HUMAN SYSTEMS Efforts include: Human factors and organizational design; manpower, personnel, and training; integrated avionics, displays, and advanced cockpit; and pattern recognition. As directed by the Secretary of Defense, this activity reflects an increase from FY 2008 to FY 2009 for Basic Research (6.1) to fund peer-reviewed research to develop innovative solutions and enhance the science and engineering base. The increase also includes the Basic Research Challenge which is a	7.486	13.966	15.733	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
competitive investment based on proposed scientific activities. The increase in funding in FY 2010 reflects an increased emphasis in immersive sciences for training, cognitive and neural sciences, research in learning and decision models and computational and algorithmic approaches to behavior of individuals, social groups and networks. *FY 2008 Accomplishments:* - Continued research of social networks for counterterrorism. - Continued expansion of the cognitive architectural modeling capability to increase coverage, including spatial reasoning, multi-tasking, and impact of physiological and stress variables, etc. - Continued research of human cognition and performance to create more realistic simulations for training. - Continued program to combine cognitive architectures with computational neuroscience to better predict human performance. - Continued program on implantable electronics for performance enhancement. - Continued research of hierarchical, cellular, and hybrid organization structures for command and control. - Continued schema theory applications to multi-echelon command decision making. - Continued investment in natural language interaction capability for artificially intelligent training systems. - Continued research of neuro-control of high-lift bioinspired Unmanned Underwater Vehicles and active vision and cognitive navigation skills in mobile robots. - Continued computational neuroscience for novel pattern recognition and sensory augmentation. - Continued social-science based computational toolsets for terror network analysis at PACOM'S Joint Intelligence Center and on the USS TARAWA (LHA-1) to support Expeditionary Strike Group One in Overseas Contingency Operations. - Continued investigations to support new missions for Expeditionary Strike Groups in three areas: 1) analysis and diagnosis of Command and Control Organizational structures; 2) effects-based operations and development of reach-back capability for course of actions analysis; and 3) decision support systems for management of Battle Rhythm. - Continued research of human-robot interaction to support team collaboration.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued computational and agent-base modeling and experimentation to explore options for Effects-Based Operations. - Continued models of operational decision making for component commanders of an Expeditionary Strike Group with special emphasis on elaboration and planning knowledge. - Continued research of integrated parallel optimization models of adaptive function and responsibility reallocation between commanders/staff and reconfiguration of the command, control, and communication organizational structures. - Completed research on adaptive command and control architectures in support of the Navy's new Maritime Strategy. - Initiated the output human performance usability models with actual human performance results obtained in usability testing on systems under development. These systems include future Naval Combat Systems and Homeland Security Operation Centers. - Initiated investigation of human sensory performance for optimizing video and audio human-electronic device interfaces. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Initiate research to create new social modeling tools for understanding the responses of adversaries, determining the best practices for containing and deterring the adversary, and developing effective course of action in non-Western environments for humanitarian and civilian-military operations. - Initiate research of advanced biometrics such as biodynamic signatures to support spiral 2 and 3 of Navy Identity Dominance System Maritime Domain. - Initiate efforts to extend the representational capabilities of cognitive architectures to accommodate aspects of social cognition and teamwork. - Initiate efforts to develop an empirical understanding and prediction of the behaviors of individuals and social groups and networks, computational approaches to social network theory and the co-evolution of adversarial tactics and strategies, algorithms for exploring scenarios that take into account socio-cultural factors; political and economic factors; local attitudes, values, and social structure. - Initiate research focused towards cognitive and neural sciences, virtual/immersive environment simulators, decision models for improved warfighter performance.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2010 Plans: - Continue all efforts of FY 2009. - Initiate research of human activity and intend recognition and dynamic biometrics for improved human system interfaces and force protection. - Initiate research into probabilistic reasoning in computation cognitive architectures.					
INFORMATION SCIENCES		23.733	32.299	33.583	
Efforts include: Mathematical foundation and 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). As directed by the Secretary of Defense, this activity reflects an increase in FY 2009 and out for Basic Research (6.1) to fund peer-reviewed research to develop innovative solutions and enhance the science and engineering base. The increase also includes the Basic Research Challenge which is a competitive investment based on proposed scientific activities and an increased level of investment and effort for information technology for software systems. *FY 2008 Accomplishments:* - Continued development of mathematical optimization framework and heuristic algorithms that serve as theoretical and computational basis for network design, resource allocation, and logistics. - Continued development of improved tactical and battlespace decision aids. - Continued to refine techniques for extracting maximum knowledge from multi-modal imagery, text, and multi-source 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.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- 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 quantum computing and cryptography. - Continued efforts on model checking and automated theorem prover technologies. - Continued efforts on biometric technologies for authentication. - Continued efforts in physics-based modeling of natural phenomena. - Continued efforts in mathematical techniques for inverse problems, including reliable approximate solutions in 3 dimensions (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 maximizing information delivery in tactical networks via encoding information under speech. - Continued development of technology to re-engineer legacy code. - Continued development of technology to improve analysis of distributed systems. - Continued focused efforts in development of mathematical foundations for image understanding on a number of key challenges, such as multi-modal imagery representation and metrics, object recognition, scene analysis and understanding. - Continued focused university efforts on statistical data analysis of non-traditional data types, such as text, open source, and streaming data in order to develop a computational statistics framework for integrating information of disparate sources. - Continued efforts on communications and networks. - Completed development of technology for improving behavior of coordinated teams of autonomous systems. - Initiated a study of mathematical functional spaces to represent, compute, and analyze data of diverse and disparate nature in order to develop a robust computational theory for automated information integration of disparate sources of data. - Initiated development of mathematical, statistical, and computational framework leading to robust underlying approaches for automated information integration of disparate sources of data.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated development of technology for analyzing functionality of executable software code. - Initiated development of technology for assessing effectiveness of automatic translation programs. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Completed efforts on communications and networks. - Initiate research in cognitive radio and networking protocols. - Initiate research on novel switched mode techniques to overcome radiation efficiency limit in electrically small antennas. - Initiate research in cross-layer wireless protocols for delay sensitive network traffic. - Initiate multidisciplinary research efforts to focus on intelligent control systems, cooperative behavior modeling and response, UxV-human interactions and adaptive mission methodologies. - Initiate development of an interaction model of how users characterize visual content and context to improve video surveillance. - Initiate development of improved formal foundations, methods, and tools for compositional verification and construction of high assurance software systems. - Initiate investigation of relational constructive induction, semi-supervised learning, and classifier ensembles to improve Collective Classification technology and operations based automated decision aids. - Initiate multidisciplinary research efforts to focus on intelligent control systems, cooperative behavior modeling and response, UxV-human interactions and adaptive mission methodologies. - Initiate research aiming to develop principled, trustworthy, yet practical and usable approaches to address the issue of software producibility and the development of complex software systems with ensured interoperability. - Initiate research into Anti-Tamper and Information Assurance: research focused on protection techniques, architectures, algorithms, protocols that allow for security and cyber situational awareness. - Initiate research on novel switched mode techniques to overcome radiation efficiency limit in electrically small antennas. - Initiate research to develop mathematical and computational tools for compressive sensing. - Initiate the development of theory and algorithms for quantum communications.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Increase basic research into the extraction of information from large data sets. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Initiate basic research efforts addressing the representation, computation, and analysis of information from large diverse data sets. - Initiate research efforts to develop tools for proactive information assurance and cyber space security.					
MATERIALS/PROCESSES Efforts include: Structural materials; functional materials; maintenance reduction; Environmental Sciences; and Manufacturing Science. Accomplishments and plans described below are examples for each effort category. This activity also includes Secretary of Defense directed peer-review basic research to develop innovative solutions and enhance the science and engineering base. *FY 2008 Accomplishments:* Structural Materials - Continued development of first-principles based methodologies for predicting the thermodynamics and kinetics controlling microstructural evolution for the design of advanced weldable, naval steels. - Continued development of models and simulations to understand and predict high deformation rate blast behavior for engineered topological structures. - Continued development of materials and fabrication science for fugitive phase processes for engineered topological structures for ship blast protection. - Continued quantification of the corrosion effects on fatigue to be incorporated into the Unified Damage Model and validate in a few environmental cases on P-3 aircraft real loads data. - Continued developing carbon nanotubes growth and mechanical behavior in advanced composites for next generation ship and aircraft structures.		56.015	58.994	60.111	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued development of 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. - Continued development of progressive damage models for blast effects on composite marine structures. - Continued development of theoretical basis for composite materials behavior based on x-ray computed micro-tomography. - Continued development of understanding and constitutive models of dynamic behavior of naval steels. - Continued evaluating environmental effects on marine composites and sandwich structures. - Continued exploration of composition, processing and microstructural evolution in titanium alloys for marine structures. - Continued exploration of multienergy processes for zero maintenance coatings. - Continued first lubrication-by-design experiments. - Continued high temperature, low frictional sliding coefficient materials for elevated operating temperature gas turbine engine bearings. - Continued investigation of a rapid annealing of surface layers and their effects. - Continued multi-scale (atomic to microscopic) physics/chemistry-modeling of friction, wear, and lubrication for the rational design of high performance bearings, gears, seals, and lubricants. - Continued research tools design efforts in chemical dynamics. - Continued research tools design efforts in dynamic three dimensional control of structures. - Continued the investigation of processing science (single crystals, coatings, thermal barrier coatings (TBC), heat treatment, etc) to materials performance for turbine engine components to develop relevant process protocols to optimize and control quality. - Continued to advance the understanding of processing and deformation mechanisms in nanostructured ceramic composites and metal alloys to provide new high strength-high toughness materials for Naval platforms. - Continued to develop the science of sliding contact and lubrication using physical and chemical first principles. - Continued to investigate the use of photorefractive crystals for the demodulation of a distributed fiber optic Bragg gratings structural health monitoring system. - Completed research into the area of transforming bio-fibrillose material into carbon nanotubes.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Completed evaluation of new high temperature resin for potential Unmanned Combat Air System (UCAS) high temperature composite applications. - Initiated research on new hybrid composites that integrate polymers, structural fibers, carbon nanotubes, ceramics and metals, with improved blast, ballistic, fire resistance and mechanical characteristics with special emphasis at the interfacial aspects of the new materials. - Initiated efforts to understand and predict salt chemistry effects on high temperature coatings and materials in naval gas turbine environments. - Initiated understanding for development of modeling tools for enhancing dynamic response and projectile resistance for sandwich structures. Functional Materials - Continued research tools design efforts in electromagnetic and acoustic bandgap materials. - Continued study of new transduction mechanisms. - Continued development of the science and technology base for a highly efficient and stable flexible organic solar cell. - Continued effort to fabricate extended 2D left handed materials (LHM) structures. - Continued examination of the effects of acoustic perturbations and interactions in reacting flows and determine how they can be used. - Continued exploration and prediction of new sonar materials based on first principle methods. - Continued extension of 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. - Continued first principle methods to calculate second and third rank tensor properties of sonar materials such as lead zirconate titanate and lead magnesium niobate. - Continued investigation into the properties and fabrication of novel ceramics which have potential to combine hardness, strength, and high transmission in the long wave infrared (LWIR) spectral region. - Initiated exploration of innovative technologies such as capacitive micro-machined acoustic transducers for naval sonar systems. - Initiated study of standoff detection of explosive materials and devices.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated development of methods for the intentional, controlled, impurity doping of semiconductor nanocrystal wires. - Initiated effort to synthesize beta-SiC power suitable for subsequent densification into transparent beta-SiC ceramic. - Initiated meta-materials effort to develop negative index materials with dynamic frequency response. - Initiated synthesis and property measurement of new sonar materials predicted by first principle methods. Maintenance Reduction - Continued development of corrosion models. - Continued mechanistic studies of materials deterioration under chemical environment for ship materials and their interfaces. - Continued 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 tailor compressive stresses. - Continued mechanism-based modeling of H-assisted cracking in ultra high strength steels. - Continued stainless steel carburization study to enhance corrosion performance. - Continued studies on understanding and modeling sea water corrosion effects of thermal cycling of AA 5XXX series. - Initiated the concept study of multiscale corrosion modeling on naval ship materials. - Initiated fundamental theoretical and experimental studies on nanoscale corrosion of metals and alloys. - Initiated corrosion prediction using an integrated deterministic-based model. - Initiated grain boundary engineering to improve corrosion resistance of marine grade aluminum alloys. - Initiated modeling and simulation of corrosion phenomena. Environmental Science - Continued examination of scientific methods for pollution prevention, waste reduction, and hazardous material reduction for Naval Operations. - Continued assessment of the fate and effects of chemical and biological contaminants in marine/ estuarine environments.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued broad based program in anti-fouling and fouling release coatings including investigation of effect of new polymers, materials, processes, and novel testing methodologies for coating efficacy. - Continued effort to determine most promising foul-release approaches based on silicones to meet Navy durability requirements. - Continued research tools design efforts in Sampling and Analytical Methodologies. - Continued effort to develop Reverse Osmosis (RO) pre-treatment strategies to allow water recycling on ships. - Initiated efforts on treatment strategies of oily water containing synthetic lubricants. *FY 2009 Plans:* Structural Materials - Continue all efforts of FY 2008, less those noted as completed above. - Complete development of 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. - Complete research tools design efforts in dynamic three dimensional control of structures. - Complete research tools design efforts in chemical dynamics. - Complete development of progressive damage models for blast effects on composite marine structures. - Initiate multi-energy processing approaches for the room temperature cure of polymeric materials with high temperature thermoxidative stability and fire resistance. - Initiate the fatigue life prediction model analysis on high temperature engine materials. - Initiate development of new methods for room temperature curing and processing of polymer composites with high temperature oxidative stability and fire resistance. - Initiate assessment of the blast resistance of cellular structures as functions of soil characteristics. - Initiate development of seamless ceramic joining technology for the fabrication of large, complex shape conventional ceramic windows for IR, radar and visible light shipboard systems from small, inexpensive components using electrophoretic deposition of ceramic nanoparticles. - Initiate development of understanding and constitutive models of competing and complementary microstructural factors influencing both dynamic behavior and weldability of high strength steels and naval titanium alloys.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiate expansion of first-principles methods devised to calculate piezoelectric properties of materials for sonar transducers to calculate additional materials properties for other applications. - Initiate materials and fabrication science for fugitive phase processes for engineered topological structures for vehicle blast and fragmentation protection. Functional Materials - Continue all efforts of FY 2008. - Initiate design, processing, and measurements to fashion the new generation of high-strain, high coupling piezoelectric single crystals into high-performance acoustic transducers for naval sonar systems. - Initiate basic research into material technology associated with the development of active and conventional armor. - Initiate effort to characterize regenerative bacterial nanowires. - Initiate effort to synthesize cyclic peptide ring modules and polymerize them into peptide nanotube polymers. - Initiate efforts to utilize chemically modified virus proteins as a scaffold to assemble nanostructured metamaterials with unique optical properties including negative index of refraction. - Initiate effort to develop surface electrons on diamond. Maintenance Reduction - Continue all efforts of FY 2008. - Complete identification of 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. - Initiate the investigation of processing science (single crystals, coatings, thermal barrier coatings (TBC), heat treatment, etc) to materials performance to develop relevant process protocols to optimize and control quality. - Initiate studies of surface microstructure optimization to enhance corrosion properties of navy marine alloys - Initiate sensor development for monitoring microstructural changes on alloys under thermal and mechanical stresses.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiate research focused on modeling and simulation for platform and system affordability, lifetime materials, shipboard wireless capability, automation to reduce manning. Environmental Science - Continue all efforts of FY 2008. - Complete assessment of the fate and effects of chemical and biological contaminants in marine/ estuarine environments. - Complete research tools design efforts in Sampling and Analytical Methodologies. Manufacturing Science - Initiate a multidisciplinary research task into furthering the sciences associated with advances in manufacturing processes. *FY 2010 Plans:* Structural Materials - Continue all efforts of FY 2009, less those noted as completed above. - Initiate exploration of fundamental mechanisms and initiate development of physics-based models of electrophoretic deposition of ceramic nanoparticles and subsequent sintering. - Initiate physics based models for coupled phenomena in marine composite structures (thermo-mechanical loads, environmental effects, and fluid-structure interactions.) - Initiate research on innovative concepts for effective radiation barrier coatings and ultra-low thermal conductivity barrier coatings. Functional Materials - Continue all efforts of FY 2009. - Complete first principle methods to calculate second and third rank tensor properties of sonar materials such as lead zirconate titanate and lead magnesium niobate. - Initiate efforts to develop oxide materials for power management, sensors, and information storage/ processing				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Maintenance Reduction - Continue all efforts of FY 2009, less those noted as completed above. - Initiate development of ab initio models of corrosion reactions. - Initiate development of coatings capable of actively responding to environmental stresses. - Initiate study of coating failure mechanism on coating-substrate interface. - Initiate research on innovative concepts for effective radiation barrier coatings and ultra-low thermal conductivity barrier coatings. Environmental Science - Continue all efforts of FY 2009, less those noted as completed above. Manufacturing Science - Continue all efforts of FY 2009.					
MEDICAL/BIOLOGY Efforts include: Biosensors, bioprocesses, and bio-inspired systems; casualty care and management; healthy and fit force; casualty prevention; undersea medicine/hyperbaric physiology; biorobotics; expeditionary operations training; and chemical-biological defense. These efforts are coordinated with the Army and Air Force through joint program reviews and are complementary, not duplicative. This activity also includes Secretary of Defense directed peer-review basic research to develop innovative solutions and enhance the science and engineering base. *FY 2008 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).		14.416	16.909	18.230	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued work in understanding the mechanisms of decompression illness and hyperbaric oxygen toxicity. - Continued work on genomics/genetics of infectious organisms of military relevance and signal of transduction. - Continued research in casualty care and management and casualty prevention, including investigations of mechanisms of hemorrhagic shock, blast injury, tissue repair, and the biomedical effects of military operational exposures such as directed energy, hazardous chemicals, and sound. - Continued research in Genetic Polymorphisms, the stress response and their Interaction with the Immune System. - Continued research to explore systematic relationships between cognitive and physiological responses to laboratory tasks under operational conditions. - Completed research in healthy and fit force. - Initiated research in the mechanism/effects of underwater thermal stress. - Initiated research in understanding skull bones injury and healing dynamics. - Initiated research to discriminate fatigue and stress performance effects. Biological Sciences - Continued work to power naval ocean instruments with sediment biofuel cells and to elucidate the microbial processes that drive energy harvesting in these systems. - Continued research on biofouling with emphasis on barnacle adhesion studies using molecular biology tools. - Continued work on microbial synthesis of energetic materials. - Continued research of toxicity and enzymatic pathways of biodegradation of Royal Demolition Explosive (RDX), High Melting Point Explosive (HMX) and Dinitrotoluene (DNT) in marine benthos. - Continued efforts focused on microbe-materials interfacial interactions to detect materials defects/ failures. - Continued research on biofouling microbial community succession and invertebrate larval settlement in response to biofilms. - Continued biogeochemical research of Mississippi Sound sediments: Hurricane Katrina effects and recovery.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued research to understand physiological effects of sound exposure on marine mammals from Navy sound sources other than sonar. - Continued efforts in “smart cell engineering” to design microbes that can sense and destroy other microbes through antibiotic production, or can “sense” and qualify their surrounding environment and provide information back to the user. - Continued combinatorial chemical screens for bacterial communication pathway inhibitors as potential antibiotics or fouling-control agents. - Continued work to power naval ocean instruments with sediment biofuel cells and to elucidate the microbial processes that drive energy harvesting in these systems. - Completed efforts directed at genomics-enabled anaerobic transformation of polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) in estuarine sediments. - Completed efforts focused on eelgrass-mediated degradation of PAHs and PCBs. - Completed efforts to develop next-generation and supramolecular antibiotics. - Completed dolphin microarray and gene-based studies to facilitate immunobiology studies of stress response. - Initiated efforts to engineer plants to produce high value naval materials. - Initiated efforts utilizing metagenomic screens to identify novel bacterial activities related to nitration or synthesis of high-N heterocycles. - Initiated efforts to develop ultra-fast methodology for selecting DNA biosensor molecules. - Initiated research to generate label-free assays for biosensing at biointerfaces. - Initiated research to identify inhibitors of lateral DNA transfer in bacteria. - Initiated work to identify plasma biomarkers of domoic acid toxicosis and leptospirosis in California sea lions, and develop a multiplexed assay to measure those plasma biomarkers. *FY 2009 Plans:* Medical Sciences - Continue all efforts of FY 2008, less those noted as completed above. - Initiate research in genetic basis of psychological stress. Biological Sciences				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continue all efforts of FY 2008, less those noted as completed above. - Complete research on biofouling microbial community succession. - Complete efforts on biomimetic adhesives for underwater use. - Complete biogeochemical research of Mississippi Sound sediments: Hurricane Katrina effects and recovery. - Complete research on toxicity and enzymatic pathways of biodegradation of Royal Demolition Explosive (RDX), High Melting Point Explosive (HMX) and Dinitrotoluene (DNT) in marine benthos. - Initiate increased emphasis in efforts focused on microbe-materials interfacial interactions for detection of materials defects/failures, including corrosion, and for improved energy harvesting. - Initiate increased emphasis in research on invertebrate larval settlement and metamorphosis in response to biofilms and various inhibitors of adhesion. - Initiate efforts to identify molecular biomarkers for battlefield injuries, and high-fidelity biosensors for detection in vivo. - Initiate research into biomolecular 'logic controllers' for in vivo biosensor and in vivo drug delivery systems. - Initiate research on engineered cells for infection detection and treatment in wounds. - Initiate research efforts focused on developing bio-inspired sensors, vehicles and systems for local ISR, WMD detection, personnel protection and affordability. Research elements include advances in microfabrication, biological materials, processing techniques, robustness and efficiency of systems. *FY 2010 Plans:* Medical Sciences - Continue all efforts of FY 2009. - Initiate research on diving in contaminated/polluted water and sediment. - Initiate research on long-term effects of exposure to submarine environments. - Initiate research on physiological and genetic effects of long-term diving. Biological Sciences - Continue all efforts of FY 2009, less those noted as completed above.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate efforts to ascertain potential human health and environmental risks of novel nanomaterial-based ammunition primers. - Initiate research on stem cells in marine mammals and their potential clinical role. - Initiate development of a second set of molecular diagnostic tests for recently discovered viral pathogens of marine mammals.					
OCEAN SCIENCES Efforts include: Littoral Geosciences and Optics; Marine Mammals and Biology; Physical Oceanography and Prediction; and Ocean Acoustics. Accomplishments and plans described below are examples for each effort category. This activity also includes Secretary of Defense directed peer-review basic research to develop innovative solutions and enhance the science and engineering base. *FY 2008 Accomplishments:* Littoral Geosciences and Optics - Continued 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. - Continued field, laboratory, and numerical studies of seafloor sand ripple genesis, evolution, and destruction and their effect on acoustical penetration of the sea floor. - Continued efforts to investigate the effects of oceanic biota on the propagation and inversion of multi-frequency acoustical energy. - Continued investigations of sources and properties of light scatter within the coastal ocean. - Continued to investigate the physical processes that control re-suspension of bottom sediments and the resulting impact on optical and acoustical propagation. - Continued investigations of oceanic processes within the surface boundary layer that control high-frequency variability in image propagation and distortion.		83.737	83.257	83.108	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued to investigate and characterize the impact of riverine sources of optically-important matter on underwater visibility, navigation, and surveillance. - Continued field program to infer sea floor characteristics from observations of surface gravity waves. - Continued effort to improve accuracy of the "5-cm gravimetric geoid" and precise geodesy. - Continued effort to understand the extent and intensity of seafloor gas hydrate accumulations and coastal bio-optical response to air-ocean forcing. - Continued programs to estimate optical properties of coastal ocean water from above-surface sensing, using in-situ data for validation. - Continued studies to predict tidal flat evolution in coastal/riverine/estuarine systems. - Continued incorporation of 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. - Initiated development of prediction models for distributary deltaic coastal environments. Marine Mammals and Biology - Continued 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. - Continued new efforts on tracking of marine mammals using data fusion based on tags and remote sensing. Physical Oceanography and Prediction - Continued field studies/modeling to predict propagation and effect on acoustics of non-linear internal waves in the western Pacific. - Continued development of a ship wave radar driven wave model to allow high resolution studies of near surface ocean processes and to support Sea Basing. - Continued extensive internal wave field program off the New Jersey Shelf; field work coincided with and complemented the Shallow Water Acoustics Program. - Continued an assessment of the role of emerging sub-mesoscale parameterization techniques for improving next generation high resolution/high accuracy environmental models.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued design evaluation for a persistent mobile sampling network based on autonomous undersea vehicle platform and sensor technologies. - Continued extensive 3-year field program on prediction of internal waves. - Continued first field test of the Optimal Deployment DRI (ODDAS) in the South China Sea. - Continued 5-year program on the analysis of coherent structures in rivers and estuaries in support of the prediction and characterization of denied areas. - Continued a field and modeling program to predict mesoscale structures and rapidly-varying currents in the Philippine Archipelago using Synthetic Aperture Radar (SAR), Hyperspectral and other remote data together with new data assimilation methods. - Continued field programs that demonstrate “persistent monitoring and measurement of environmental structures using gliders. - Continued workshops to define science needs for Sea Basing. - Continued a Coupled Oceanographic-Acoustics modeling and field program to demonstrate the use of a fully coupled system in optimizing tactical reduction of uncertainty. - Continued an integrated modeling and field experiment on determining custom self-learning wave databases and forecast systems/ship-movement and engineering systems for Sea Basing. - Continued the pilot test of the novel data (synthetic aperture radar and Hyper-spectral) assimilation forecast system developed under Philippine experiment. - Continued an Estuarine-Littoral Processes Interaction field study in muddy and tidal flat dominated regimes including a data assimilative prediction capability. - Continued studies of complex ocean currents in the Indian Ocean using gliders and remote sensing methods being developed to support tactical oceanography. - Continued studies of internal waves and strait dynamics emphasizing field studies in the Celebes, Philippine, and Sulu Seas. - Continued studies to understand how to sample ocean processes with gliders and other autonomous and remote sensing systems to support tactical oceanography. - Continued the field experiment in Monterey Bay to examine the role of unresolved processes in model parameterizations.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- 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. - Initiated development of expert system methods to characterize and predict Riverine/estuarine systems to support Naval Special Warfare, Marine Expeditionary Forces and new Riverine units. - Initiated studies of complex ocean currents in the Indian Ocean using gliders and remote sensing methods being developed to support tactical oceanography. Ocean Acoustics - Continued analysis of deep-water acoustic transmissions made in the North Pacific to understand the scattered sound field due to ocean volume variability and bathymetric features. - Continued field experiments and modeling efforts to examine the performance of Acoustic Vector Sensors. - Continued a field and modeling effort to simultaneously study shallow-water medium fluctuations and develop time-reversal communications using adaptive channel equalizers. - Continued analysis and modeling to understand the physics of buried mine detection through broadband and synthetic aperture sonar. - Continued shallow-water, shelf-break measurements and analysis to characterize the effects of the ocean water column and seabed variability on low- and mid-frequency acoustic propagation and scattering. - Continued a field and modeling effort to establish the capabilities of underwater acoustic communications for FORCEnet and persistent undersea surveillance. - Continued the development and testing of geo-acoustic inversion and extrapolation methods. - Continued investigations into quantifying, predicting and exploiting uncertainty in acoustic prediction models. - Continued to research effect of solitons and internal wave bores on acoustic propagation and buoyancy. - Continued studies of adaptive beam-forming using mobile, autonomous sensors. - Continued research to develop complex analytic equations that couple oceanographic modes, both horizontal and vertical, to their corresponding frequency-dependent acoustic modes to give direct acoustic prediction capability.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

- Continued research to quantify uncertainty in acoustic field computations for multi-scale ocean environments using novel approaches involving Bayesian prediction and polynomial chaos expansions to embed environmental uncertainty into multi-scale ocean dynamics and acoustic propagation.
- Continued assessment of “time-reversal” propagation techniques for mitigation of environmental variability.
- Continued development of algorithms for accurate acoustic predictions in dispersive, turbulent, turbid water.
- Continued development of source waveform design for rough littoral seafloors.
- Continued effort to develop a methodology for expressing the semantics of physics-based environmental models to support automated computer applications.
- Continued effort to understand how mudflat sediments respond to dynamic processes.
- Continued effort to understand synoptic scale ocean variability in the strategic Turkish Straits System including water mass exchange between basins and vertical mixing.
- Continued field work on adaptive beam-forming using mobile, autonomous sensors.
- Continued investigation of acoustically induced magnetic fields using modern experimental equipment and numerical techniques.
- Continued research to enhance understanding of the vibrational response of elastic structures to flow-induced excitation while developing a first-principles model for the induced structural acoustic response and reradiated acoustic field.

FY 2009 Plans:

Littoral Geosciences and Optics
- Continue all efforts of FY 2008.
- Initiate studies of tidal flat evolution in wave dominated environments.

Marine Mammals and Biology
- Continue all efforts of FY 2008.

Physical Oceanography and Prediction
- Continue all efforts of FY 2008.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Complete studies of internal wave propagation in the South China Sea. - Initiate studies of ocean and wave response to typhoons and monsoons in the Western Pacific. - Initiate studies of how to predict the 'full battle space environmental cube' using networked sensors and multiply coupled ocean/wave/atmosphere/acoustic prediction systems to provide sea base and fleet force protection. Ocean Acoustics - Continue all efforts of FY 2008, less those noted as completed above. - Initiate deep-water acoustic transmission measurements with emphasis on the Northern Philippine Sea. *FY 2010 Plans:* Littoral Geosciences and Optics - Continue all efforts of FY 2009. - Complete field, laboratory, and numerical studies of seafloor sand ripple genesis, evolution, and destruction and their effect on acoustical penetration of the sea floor. - Initiate studies of dissipation of surface gravity waves by muddy seabed sediments. Marine Mammals and Biology - Continue all efforts of FY 2009. - Initiate new efforts to examine physiology of marine mammals in situ and to predict consequences of physiological and auditory stress to populations. Physical Oceanography and Prediction - Continue all efforts of FY 2009, less those noted as completed above. Ocean Acoustics - Continue all efforts of FY 2009, less those noted as completed above. - Initiate data collection and analysis of deep water ambient noise with emphasis on the Philippine Sea.					
SCIENCE AND ENGINEERING EDUCATION, CAREER DEVELOPMENT AND OUTREACH		33.275	33.023	27.414	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. The decrease in FY 2010 represents a decrease in availability of resources. *FY 2008 Accomplishments:* - Continued awarding prizes at 400 regional high school science fairs and three national competitions. - Continued supporting high school summer interns at Navy laboratories. - Continued supporting undergraduate/graduate students as summer research interns at Navy laboratories. - Continued providing graduate fellowship support to HBCU engineering faculty candidates. - Continued funding Young Investigator research grants. - Continued encouraging, promoting, planning, coordinating and administering naval Science and Technology programs. *FY 2009 Plans:* - Continue all efforts of FY 2008. *FY 2010 Plans:* - Continue all efforts of FY 2009.				
SENSORS, ELECTRONICS AND ELECTRONIC WARFARE (EW) Efforts include: Sensing, diagnostics, and detectors; navigation and timekeeping; nano-electronics; wide band gap power devices; real-time targeting; Electro-Optical/Infra Red (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; Integrated Topside Innovative Naval Prototype (ITS INP); and RF electronic warfare.	40.582	47.137	51.208	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
As directed by the Secretary of Defense, this activity reflects a increase from FY 2009 and out for Basic Research (6.1) to fund peer-reviewed research to develop innovative solutions and enhance the science and engineering base. The increase also includes the Basic Research Challenge which is a competitive investment based on proposed scientific activities. *FY 2008 Accomplishments:* - Continued monolithic integration of multifunctional materials to enable passive devices and sensors into wide bandgap semiconductor circuits. - Continued project to develop linear higher power microwave wide bandgap semiconductor bipolar transistors based on distributed polarization effect (graded composition) base growth and processing technology. - Continued effort to increase power conversion efficiency in an organic plastic solar cell based on Carbon 60 and a transparent hole transporter, and a conducting polymer electrode with achievement of > 4% - Continued investigation of physical basis for improved time and frequency standards using quantum-entangled ions and atoms. - Continued non-cooperative target identification from multiple aspects. - Continued investigation of ultra high speed logic and multiple-quantum-well devices with a goal of >500 giga-hertz (GHz) samplers, in support of mixed signal circuits for receiver analog-to-digital converters (ADC's). - Continued program to extend device performance and architectures to frequencies approaching tera hertz (THz). - Continued program to incorporate Magnesium Diboride (MgB2) tunnel junctions into simple electronic logic structures. - Continued study to determine if the coupling between spins in quantum dots mediated by the virtual excitons is sufficiently strong for use in solid state implementations for quantum information. - Continued program on advanced epitaxial growth for novel Si-based detector applications. - Continued development of a blind adaptive beamforming approach for the High Frequency (HF) radar case and compare with both the conventional and traditional approaches.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued development of approaches for probability of detection for deterministic signals in stationary noise and quantify for non-stationary noise. - Continued development of electromagnetic ultra-near-field holography. - Continued development of sensitive miniature fluxgate magnetometers. - Continued investigation of temporal-spatial noise shaping circuits and architectures for high power digital-to-analog conversion with objectives of doubling spectral bandwidth, reduction of element density (15%), and extension of multidimensional Nyquist limits to both linear and planar arrays. - Continued project to develop linear higher power microwave wide bandgap semiconductor bipolar transistors based on distributed polarization effect (graded composition) base growth and processing technology. - Continued project to lower thermal gradients between active circuit elements and heat sinks. - Continued projects to explore physical behavior of full arrays of nanoscale devices for logic, memory, and imaging. - Continued research to develop electromagnetic ultra-near-field holography. - Continued the demonstration of control of the concentrations of the defects that limit the minority carrier lifetime in SiC. - Continued the evaluation and assessment of hardware-compatible space-time algorithms for Digital Signal Processor (DSP) applications to Transmit/Receive (T/R) arrays. - Continued the growth of semiconductor quantum wires with controlled doping and heterostructure interfaces. - Continued the initial study of the coherent control of wavefunctions in quantum dots. - Continued the study of Reciprocal Quantum Logic (RQL) digital superconducting logic. - Completed the analysis and characterization of micro-motion Doppler modulation. - Completed the evaluation and assessment of hardware-compatible space-time algorithms for Digital Signal Processing (DSP) applications to T/R arrays. - Completed investigation of super-resolution signal processing techniques for closely spaced and unresolved targets in Doppler, range and direction of arrival spaces for a variety of radars. - Completed analyzing effects of maritime and urban aerosols on thermal blooming of high energy laser beams.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Completed improvements to integrated nanomechanical device arrays to include scaling down resonator architecture and quantifying properties which establish phononic crystal properties. - Completed/transitioned Cellular Nonlinear Network (CNN) fast image processor with multi-spectral focal plane array sensors to 6.2 research. - Completed analyzing effects of maritime and urban aerosols on thermal blooming of high energy laser beams. - Completed development of multi-time and length scale step modeling of heat propagation in bare and packaged wide bandgap power amplifiers, experimental verification of the models, and testing of the role of temperature in observed history effects, non-linearity, and device failure mechanisms. - Completed development of stabilized optical sources and low-noise photodetectors for the fabrication of an ultrastable microwave-frequency source. - Completed exploitation of atom condensates to reach physical limit of frequency precision and control. - Completed improvements to integrated nanomechanical device arrays to include scaling down resonator architecture and quantifying properties which establish phononic crystal properties. - Completed investigation of extension of interference model and adaptive structures to produce waveforms that are transparent to non-users. - Completed research effort to investigate multiple input multiple output (MIMO) signal analysis and characterization with application to wide area surveillance. - Completed research effort to investigate target and signal characteristics based on non-Archimedean geometry. - Completed studies to optimize power and efficiency of compact, high power, electron beam pumped Argon-Xenon (Ar-Xe) laser for Navy directed energy weapons (DEW). - Completed investigations of the modification of metal surfaces by nitriding and other processes to maximize hardness, wear and corrosion resistance for Navy gun barrel applications using the large area plasma processing system (LAPPS). - Initiated research to improve mixed signal III-V device and circuit modeling with objectives of achieving a 30 dB dynamic range improvement for complex circuits containing over 100,000 devices. - Initiated a program to apply innovative mass nanofabrication techniques to previously developed nanodevice arrays. - Initiated a program on the control of deleterious defects in silicon carbide (SiC).				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated a program on the study of Quantum Dots and their application to coherent wavefunction control and quantum information. - Initiated a program on the tailoring of the optical, structural and electronic properties of semiconductor quantum wires. - Initiated a program to demonstrate non-volatile memory, based on spin-torque Magnetic Random Access Memory (MRAM), with switching speed > 1 GHz and write currents small enough (<1 mA) to be driven by superconducting Rapid Single Flux Quantum (RSFQ) logic. - Initiated a program to determine if the newly invented Reciprocal Flux Quantum Logic in fact delivers 2x higher speeds with 5x fewer Josephson junctions and power, while using the same underlying devices so that single chip hybrid circuits between it and the dominant RSFQ logic are feasible. - Initiated a program to investigate whether pattern dependent RF currents during plasma etching are responsible for observed variability in Josephson junction characteristics in complex circuits and, if so, define design rule changes to avoid the effects. - Initiated demonstrations of tunable analog filters made in a digital Nb device foundry. - Initiated development of a general mathematical framework for developing advanced infrared countermeasures and analyzing/optimizing their effectiveness. - Initiated development of techniques to observe directly the electrical properties of pair states in high temperature superconductors. - Initiated research of a novel extension of the Generalized Radon Transform to establish appropriate wavenumber representations for arbitrarily oriented wave guides, surfaces, and structures. - Initiated work on optical manipulation of ultra-cold atoms. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Complete investigation of extension of interference model and adaptive structures to produce waveforms that are transparent to non-users. - Complete non-cooperative target identification from multiple aspects. - Complete development of a general mathematical framework for developing advanced infrared countermeasures and analyzing/optimizing their effectiveness. - Complete the demonstration of single and two-qubit operations of spins in quantum dots.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Complete the study of defects involved in limiting the minority carrier lifetime in SiC. - Complete the study of the use of InAs, Ga2O3 quantum wires for optical, structural and electronic applications. - Initiate project to explore graphene based nanoelectronic devices. - Initiate program in chip-scale quantum architectures. - Initiate project to reduce heat transfer through electrical leads in cryogenic packaging. - Initiate project to explore development of devices, sigma delta and time encoder circuits for near THz switching with objectives of enabling analog and digital conversion at millimeter wave frequencies. - Initiate high-sensitivity magnetometry using quantum logic. - Initiate materials studies of low temperature regenerator (high thermal capacity) materials and/or controlled flow microstructures with the goal of improving energy efficiency of cryocoolers. - Initiate research into fundamental concepts and mathematics for digital array architectures. - Initiate research to apply carbon nano-tube technology to acoustic sensing. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete research effort to investigate multiple input multiple output (MIMO) signal analysis and characterization with application to wide area surveillance. - Complete research effort to investigate target and signal characteristics based on non-Archimedean geometry. - Complete the study of RQL digital superconducting logic. - Complete determination of the most appropriate tunnel barrier for MgB2 Josephson junctions. - Initiate an effort to grow low defect density, high purity epitaxial 4H-SiC at high growth rates suitable for high power electronic device applications. - Initiate design, construction, and testing of sonic crystals that can be tuned to have specific acoustic properties. - Initiate effort to create a physics-based understanding of epitaxial oxides and insulators for use in applications for advanced electronics. - Initiate investigation into stabilizing in-phase coherent state of coupled systems for coherent power generation.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate high frequency solid state power devices for active spectral load control. - Initiate high output impedance solid state device technologies and materials. - Initiate effort to fabricate functionalized micro-opto-mechanical systems for the measurement of micromechanical photothermal spectra of adsorbed chemical vapor analytes. - Initiate research effort on chemical synthesis and bandgap tailoring in graphene nanoribbons. - Initiate research on spin dynamics in Group IV semiconductors and related device concepts. - Initiate research efforts on non-conventional nanofabrication that hold promise for sub-10nm resolution. - Initiate studies of the physics origin of noise and behavioral fluctuations in superconducting circuits, especially analog to digital converters, and incorporate the understanding into computer aided circuit simulators. - Initiate studies of the generation and recombination dynamics of non-equilibrium quasiparticles associated with digital switching events in superconducting logic.					
WEAPONS Efforts include: Undersea Weaponry; Energetic Materials and Propulsion; Expeditionary Operations (communications, materials for forensic sensing, landmine detection, human sensory enhancements, lightweight power sources and information efficiency); Directed Energy; and Applied Electromagnetics. This activity also includes Secretary of Defense directed peer-review basic research to develop innovative solutions and enhance the science and engineering base. The increase in FY 2010 is due to a larger investment in electromagnetics science. *FY 2008 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 (ULI) Program to provide a further infusion of educated and career-minded scientists and engineers in support of the National Naval Responsibility (NNR) for Undersea Weapons Research.		12.918	15.173	19.452	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued computer code refinements and investigation of supercavitating vehicle dynamics and instability. - Continued evaluation of viable synthesis methodologies and characterization of candidate explosive ingredients suitable for undersea weapons applications. - Continued development of diagnostic capabilities to accurately determine aluminum combustion characteristics in oxidizing environments. - Continued an Otto Fuel II characterization study for undersea weapons. - Continued assessment of electro-optical technology focused on enhancing undersea warhead fuzing systems. - Continued efforts in nonlinear control laws, gas ventilation, and vehicle stability associated with the development of high-speed supercavitating vehicles (HSSV). - Continued hydroacoustics models and experiments to reduce the self noise on cavitator acoustic array. - Continued isolation and characterization of the tetranitroborate anion as a candidate ingredient suitable for undersea warheads applications. - Continued studies of low probability of intercept sonar, metalized explosives, lattice deformation of crystalline explosives, high thermal conductivity nanocomposites for vehicle arrays, microplasma fuels reforming and biomimetric propulsion mechanisms for underwater vehicles exploiting flutter instability. - Continued analysis of geological false targets for torpedo systems. - Continued fuel cell concept development using hydrogen peroxide reformate as oxidant. - Continued development of an acoustic propagation model for rapid and accurate calculations for undersea weaponry applications. - Continued the novel signal processing approach for detection and classification of countermeasures. - Completed an image compression approach to cooperative processing for swarming autonomous underwater vehicles. - Initiated development of concept for weaponized Unmanned Undersea Vehicles (UUVs) based on game to theoretic approach. Energetic Materials and Propulsion - Continued development of a fundamental understanding of initiation mechanisms of explosive crystals subjected to shock stimulus.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- 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. - Continued investigation of JP-10 combustion-based Proton-Exchange-Membrane (PEM) fuel cells. - Continued investigation of multi-tube multi-nozzle Pulse Detonation Engines (PDEs) and multi-tube common nozzle PDEs. - Continued investigation of nanometallic-hydrocarbon hybrid catalytic combustion for increased energy release rates. - Continued investigation of novel initiation techniques, optimize injection parameters, and demonstrate integrated single tube operation for PDEs. - Continued 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. - Continued to develop fundamental understanding of nitramine and perchlorate decomposition mechanisms for propellant applications. - Continued to develop organometallic-based highly energetic ingredients. - Continued efforts to explore alternative fuel concepts for Naval applications to include hydrogen, synthetic diesel, and biodiesel. - Continued development of multi-parameter sensor for multi-phase combustion flows (UAV and underwater PDEs). - Continued implementation of new & nanostructured materials design concepts for direct energy conversion and waste energy conversion. - Continued investigation of integrated pulse detonation engine-airframe for autonomous vehicles, and pulse detonation for passive weapons (noise, jamming). - Continued studies to determine the best investment of technologies for Unmanned Undersea Vehicle (UUV) Guidance and Control (G&C). - Continued hydroacoustics models and experiments to reduce the self noise on cavitator acoustic array. - Continued acoustic signal processing algorithms for HSSV guidance and control. - Continued development of new concepts for underwater power generation.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued development of non-lethal undersea warheads for Overseas Contingency Operations. - Continued development of PDE for underwater applications. Expeditionary Operations - Continued investigation of catalysts that reduce the pre-processing requirements for using logistic fuels in solid oxide fuel cells. - Completed investigation of modeling and exploiting the nonlinear seismic interactions between buried land mines and their surrounding soil for purposes of landmine detection. - Initiated research in quantum optics, nano-microscale self assembly and molecular recognition for active forensic sensing. Directed Energy - Continued research thrust in directed energy weapons. - Initiated directed energy development in the areas of advanced optical components and coatings for high energy lasers, high power injector and photocathode development, beam control and tracking research, terahertz source development and applications, femtosecond laser application studies, and the modeling and simulation of high power laser operation. *FY 2009 Plans:* Undersea Weaponry - Continue all efforts of FY 2008, less those noted as completed above. - Complete efforts in nonlinear control laws, gas ventilation, and vehicle stability associated with the development of high-speed supercavitating vehicles (HSSV). - Complete hydroacoustics models and experiments to reduce the self noise on cavitator acoustic array. - Complete assessment of electro-optical technology focused on enhancing undersea warhead fuzing systems. - Complete analysis of geological false targets for torpedo systems. - Complete fuel cell concept development using hydrogen peroxide reformate as oxidant. - Initiate validation of hydroacoustic models and test and evaluate acoustic array signal processing algorithms.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiate study on propulsion and its interaction with supercavitating cavity, and control surfaces. - Initiate acoustic concepts formulation and modeling for low-noise bio-inspired propulsion systems. - Initiate concept development on inversion of swarm dynamics for underwater tactical applications. - Initiate new coating concepts for corrosion and anti-fouling protection of UUVs. Energetic Materials and Propulsion - Continue all efforts of FY 2008. Expeditionary Operations - Continue all efforts of FY 2008, less those noted as completed above. Directed Energy - Continue all efforts of FY 2008. - Initiate multi-disciplinary efforts to include coherent beamforming, beam correction, turbulence effects on propagation, materials for high energy systems and sources. - Initiate basic research into mechanisms and concepts supporting the defeat of and protection against speed of light weapons. Applied Electromagnetics: - Initiate program to conduct basic research and theoretical analysis in electromagnetic phenomena in the spectrum from microwaves to visible light. Areas of research will be in microwave directed energy, optical directed energy (lasers), terahertz sources, and related nanometer-scale electronics and sensors. *FY 2010 Plans:* Undersea Weaponry - Continue all efforts of FY 2009, less those noted as completed above. - Complete a proof-of concept demonstration of a potential electro-optical technology enhancement capability for undersea warhead fuzing systems. - Complete isolation and characterization of the tetranitroborate anion as a candidate ingredient suitable for undersea warheads applications.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Complete development of an acoustic propagation model for rapid and accurate calculations for undersea weaponry applications. Energetic Materials and Propulsion - Continue all efforts of FY 2009. Expeditionary Operations - Continue all efforts of FY 2009. Directed Energy: - Continue all efforts of FY 2009. - Complete research in turbulence effects on propagation, optical component development, injector and photocathode research, and beam control. - Initiate research into advanced theoretical research and modeling of superconducting laser elements as used in advanced high energy accelerators. Applied Electromagnetics: - Continue all efforts of FY 2009.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 01 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601153N DEFENSE RESEARCH SCIENCES	PROJECT NUMBER 0000

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601101E/Defense Research Sciences									Continuing	Continuing
PE 0601102A/Defense Research Sciences									Continuing	Continuing
PE 0601102F/Defense Research Sciences									Continuing	Continuing
PE 0601103N/University Research Initiatives									Continuing	Continuing
PE 0601152N/In-House Laboratory Independent Research									Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Defense Basic Research seeks to improve the quality of defense research conducted predominantly through universities and government laboratories. It also supports the education of engineers and scientists in disciplines critical to national defense needs through the development of new knowledge in an academic environment. Initial research focus is generally conducted in an unfettered environment because of the nature of basic research, but as more is learned and applications emerge, individual research projects take on a more applied focus. Individual project metrics then become more tailored to the needs of specific applied research and advanced development programs. Example metrics include a biporous wick structure for thermal management of power electric modules capable of removing 900 watts per square centimeter which was recently developed by an academia/industry team. The National Research Council of the National Academies of Science and Engineering's congressionally directed "Assessment of Department of Defense Basic Research" concluded that the DoD is managing its basic research program effectively.

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	103.744	98.651	59.787						Continuing	Continuing
0000: POWER PROJECTION APPLIED RESEARCH	103.744	98.651	59.787						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE supports both advanced technology research and near to mid-term transition opportunities. The advanced research focus is primarily on High Energy Lasers (HEL), Electromagnetic railgun development, advanced rocket propulsion, electro-optic/infrared (EO/IR) sensor technologies. The mid-term effort is focused on developing and demonstrating technologies supporting the Future Naval Capability (FNC) Program Enabling Capabilities (ECs) for Marine and Unmanned Vehicle Tactical Intelligence, Surveillance and Reconnaissance (ISR), Advanced Naval Fires Technology, Hostile Fire Detection and Response, Weapons of Mass Destruction (WMD), and Dynamic Target Engagement & Enhanced Sensor Capabilities. 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.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	**R-1 ITEM NOMENCLATURE** PE 0602114N POWER PROJECTION APPLIED RESEARCH

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	106.667	79.913	79.343	
Current BES/President's Budget	103.744	98.651	59.787	
Total Adjustments	-2.923	18.738	-19.556	
Congressional Program Reductions		-0.279		
Congressional Rescissions				
Total Congressional Increases		19.200		
Total Reprogrammings	-0.124			
SBIR/STTR Transfer	-0.812			
Congressional Action - Realignment of congressional add from NAVY to ARMY	-1.987			
Program Adjustments			-19.715	
Rate/Misc Adjustments		-0.183	0.159	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **ADVANCED PROPULSION FOR GUN LAUNCHED PROJECTILES AND MISSILES**	0.772	0.000
Project: 9999, **AGING MILITARY AIRCRAFT FLEET SUPPORT**	1.164	1.596
Project: 9999, **CLUSTERED MILLIMETER WAVE IMAGING SENSORS & MANUFACTURING**	1.545	0.000
Project: 9999, **COMBUSTION LIGHT GAS GUN PROJECTILE**	3.085	3.988
Project: 9999, **ELECTRONIC MOTION ACTUATION SYSTEMS**	0.000	0.798
Project: 9999, **HIGH ENERGY CONVENTIONAL ENERGETICS (PHASE II)**	4.911	3.190
Project: 9999, **HIGH POWER FREE ELECTRON LASER DEVELOPMENT FOR NAVAL APPLICATIONS**	1.987	2.394
Project: 9999, **MARINE MAMMAL HEARING AND ECHOLOCATION RESEARCH**	0.000	1.596
Project: 9999, **MARINE MAMMALS - EFFECTS OF SOUND**	0.772	0.000
Project: 9999, **MILLIMETER WAVE IMAGING**	0.000	1.596
Project: 9999, **MODULAR PAYLOAD SYSTEMS**	1.934	0.000
Project: 9999, **MULTIFUNCTIONAL OXIDE MATERIALS APPLICATIONS AND DEVICES (MFMA)**	1.931	0.000

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **STRIKE WEAPON PROPULSION (SWEAP)**	1.928	2.394
Project: 9999, **UNMANNED AERIAL VEHICLE FUEL CELL POWER SOURCE WITH HYBRID REFORMING**	1.937	1.596

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH					PROJECT NUMBER 0000	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
0000: POWER PROJECTION APPLIED RESEARCH	103.744	98.651	59.787						Continuing	Continuing

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 ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
DIRECTED ENERGY AND EM GUNS (FORMERLY ELECTRIC WEAPONS)	43.016	47.817	36.895	

The goal of this activity is to develop Directed Energy (DE) and Electric Propulsion power weapons for Navy applications. The Directed Energy portion of this activity consists of two elements. The first element involves applied research and development of technologies supporting advanced accelerators with applications to directed energy weapons. The second portion of activity is the Free Electron Laser (FEL)Innovative Naval Prototype (INP)which if successful could be applicable for shipboard applications as a defensive weapon against advanced cruise missiles and asymmetric threats. The other major component in this activity is the Electro Magnetic (EM) gun program 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.

The increase from FY 2008 to FY 2009 is due to a larger investment in advance technology component development and testing required as the FEL program progresses to the higher power weapons-level outputs. Decrease from FY 2009 to FY 2010 is due to the reduction of 6.2 investment in the EM railgun and Direct Engery. The amount of the decrease was partially offset by the increase of the Free Electron Laser (FEL) investment in preparation for the FEL demonstration program.

FY 2008 Accomplishments:

Directed Energy:

- Continued cryomodule and FEL component development at the FEL testing and integration facility.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued investigation into the application of FEL technology to other areas including advanced materials, optics, bioscience, medical, manufacturing, weaponization, and solid state physics. - Continued 1 micron filamentation, halo limitation, and short Rayleigh range studies. - Continued testing of Radio Frequency (RF) gun High Voltage Power Supply (HVPS) components which are required for the 100 kW high current injector. - Initiated investigations of high power microwave sources, fiber lasers, and beam control technologies for target detection, acquisition, tracking, aimpoint maintenance of DE systems for ship and air target engagements. - Initiated development of high power optical and amplifier components for high power weapons level lasers. - Initiated aero-optical mitigation techniques for DE applications. EM Gun: - Continued material, physics and thermal property research for both launchers and projectiles. - Continued launcher and projectile component investigations and preliminary development, lethality studies and preliminary design for projectile, Bore Life Launcher component testing, IPT and bore life consortium collaborations between industry, Navy and the Army electromagnetic launch program. - Continued bore life risk reduction tests by scaling laboratory launcher muzzle energy from 8 to 16MJ to ensure bore life characteristics of the rails and insulators apply at the higher energies. Finalized projectile conceptual designs from two industry vendors and began projectile preliminary design. - Continued conceptual design of rotating machine pulsed power. - Completed preliminary design of the electromagnetic demonstration launchers with industry partners. - Completed investigation of surface treatments such as advanced coatings or "MAX-phase" materials to harden the rails in electromagnetic railguns. - Completed development of designs for viable novel electric weapon architectures that enhance performance and maintainability. - Initiated preliminary designs of pulse power systems and begin examination of system interface with ship integration.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

FY 2009 Plans:

Directed Energy and Accelerator Research:

- Continue all efforts of FY 2008, less those noted as completed above.
- Continue applied directed energy and accelerator research in: Compton radiation scattering, multiple dielectric thin film coatings, bunch characteristics of electron beam emittance, high grade electromagnetic field generators, electron beam lattice configuration, novel electron beam generation, novel high flux subatomic particle emission, high gain photonic amplification, fundemental power efficiency conversion. In addition continue the development of physics based models for: characterization of subatomic particle interaction and propagation and modeling for validation of photon control structures.
- Initiate Innovative Naval Prototype (INP) program for FEL.

EM Gun:

- Continue material, physics and thermal property research for both launchers and projectiles.
- Continue launcher and projectile development.
- Continue preliminary design and lethality studies of projectile, design of next generation pulse power systems, IPT and Bore Life Consortium collaborations.
- Initiate development of modeling and simulation capability to support bore life development and testing.

FY 2010 Plans:

Directed Energy and Accelerator Research:

- Continue all efforts of FY 2009.
- Continue applied DE and accelerator research efforts of FY09.
- Continue Innovative Naval Prototype (INP) program for the FEL. The FEL INP will design, develop, demonstrate and test an FEL that will operate at a weapons level power output (approximately 100 kW).

EM Gun:

- Continue all efforts of FY 2009.

Applied Electromagnetics for High Power Weapons:

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate a program to conduct applied research into applied electromagnetics as it applies to lasers, high power microwaves, and advanced sensors, including Modeling and Simulation tools for Directed Energy Weapons.					
HIGH SPEED PROPULSION AND ADVANCED WEAPON TECHNOLOGIES The high speed weapons work in this activity is focused on demonstrating propulsion and vehicle technologies for Mach3+ to Mach8 capable weapons. The solid rocket motor Integrated High Performance Rocket Propulsion Technology (IHPRPT) technology development activities will provide improved rocket based weapon performance. The rocket technologies apply to both air dominance and strike weapons and will provide both improved range and speed. This work includes technologies associated with high acceleration capable projectile structures, high temperature and high strength materials to enable projectiles to survive high speed launch environment, improved thermal prediction methodologies and test techniques, wide dynamic pressure adaptable projectile controls and non-explosively launched lethal mechanisms. The high speed projectile technologies are intended to support long range Naval Fire Support weapons. Decrease from FY 2008 to FY 2009 is due to additional high speed weapons ground testing in FY 2008. The decrease from FY 2009 to FY 2010 is due to the completion of the IHPRPT program. *FY 2008 Accomplishments:* Integrated High Performance Rocket Propulsion Technology (IHPRPT): - Continued demonstration of air-to-air system that uses new energetic ingredient compositions to meet Phase III IHPRPT performance goals. - Continued development of surface launch component technologies. Asymmetric Threat & Laser Control Technologies: - Continued development of propulsion and high temperature materials technologies to enable high speed weapons. - Continued demonstrating dual mode warhead effectiveness in both above and below water detonations.		9.622	7.741	1.557	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2009 Plans: Integrated High Performance Rocket Propulsion Technology: - Complete program through demonstration of Solid Rocket Motor Phase III goals at the subsystem level. Asymmetric Threat & Laser Control Technologies: - Initiate high speed projectile technology development. - Initiate High Power Microwave (HPM) technology development. *FY 2010 Plans:* High Speed Projectile & Advanced Weapon Technologies (Formerly Asymmetric Threat & Laser Control Technologies): - Continue development of compact High Power Microwave weapon systems, specifically those needed for compact source generators and compact antenna designs. - Continue high speed projectile technology development. Advanced Propulsion Technologies for Unmanned Combat Air System (UCAS): - Initiate development of technologies for a highly survivable embedded propulsion and power system which requires good thrust specific fuel consumption for missions requiring long range and endurance.					
NAVIGATION, ELECTRO OPTIC/INFRARED (EO/IR), AND SENSOR TECHNOLOGIES This activity describes Navy Science and Technology (S&T) investments in the areas of EO/IR devices and advanced sensors and includes NRL investment/performance in the technology areas of Electronics, Electronic Warfare, and Communications. The decrease from FY 2008 to FY 2009 is a result of realigning efforts more appropriately budgeted under the Strike and Littoral Combat Activity in this PE. Decrease from FY 2009 to FY 2010 is due to a reduction in NRL related EO/IR/Sensor development activities.		6.649	5.403	3.842	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2008 Accomplishments: Navigation Technologies: - Program transferred to PE 0602271N under the RF Navigation Technology activity. Electro Optic/Infrared: - Continued Millimeter Wave (MMW) and TeraHertz (THz) Imaging effort. - Continued with development of ultra low noise uncooled nanotechnology infrared sensors, and development of electronic field of view and zoom imagers. - Continued development nanoatomic sensor nonvolatile memories. - Continued development of new processes/methodologies to enable construction of composite countermeasures that fit the engagement timeline while maintaining effectiveness against existing and emerging IR guided threats. - Continued the development of an active optics system that can survey a wide area and instantly, non-mechanically zoom-in on an area of interest for target tracking/identification. Communications: - Continued covert high bandwidth communications effort. - Continued development of free space laser communications systems with the development of a hybrid infrared system with dramatically lower power requirements at the sensor/transmitter. - Continued development of Micro Air Vehicle (MAV). - Completed small hyperspectral sensor development. Autonomous Systems: - Continued design and development of a disposable MAV which will enable the airborne delivery and precision placement of miniature EW sensors and payloads. - Continued the design of an advanced auto gyrator that combines a swashplateless rotor system and active stability augmentation for autonomous systems. - Completed development of near optimal trajectory planners to enhance the capabilities of UAVs and other distributed autonomous systems. - Completed development of a compact, efficient heavy fuel engine for UAVs.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated the development of a novel beam steering method in phased array radar using optical fiber based slow light techniques. - Initiated the development of machine-vision algorithms and guidance strategies to enable the precision autonomous recovery of small sensor platforms on moving naval vessels. - Initiated the development of an autonomous soaring capability and intelligent path planning for extracting energy from the environment thereby conserving onboard fuel stores of autonomous air vehicles. - Initiated development of high power fiber lasers in mid-IR (2-5 μm) based upon highly nonlinear IR transmitting chalcogenide photonic crystal fibers. *FY 2009 Plans:* Electro Optic/Infrared: - Continue development of ultra low noise uncooled nanotechnology infrared sensors. - Continue development of electronic field of view and zoom imagers. - Continue the development of an active optics system that can survey a wide area and instantly, non-mechanically zoom-in on an area of interest for target tracking/identification. Transferred to PE 0602271N - Continue development of new processes/methodologies to enable construction of composite countermeasures that fit the engagement timeline while maintaining effectiveness against existing and emerging IR guided threats. - Continue development of high power fiber lasers in mid-IR (2-5 μm) based upon highly nonlinear IR transmitting chalcogenide photonic crystal fibers. Transferred to PE 0602271N - Complete THz Imaging project through transition to 6.3 development. - Initiate effort to develop ultra-high-sensitivity detectors suitable for use in focal plane arrays (FPAs) for the short-wave infrared (SWIR) spectral band. Transferred to PE 0602271N - Initiate effort to develop mid & Long wave IR focal plane arrays using graded-bandgap W-type-II superlattices w/much higher detectivity than that of state-of-the-art HgCdTe (MCT). Transferred to PE 0602771N - Initiate development of tunable narrowband infrared absorption technology.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Autonomous Systems: - Continue the development of a novel beam steering method in phased array radar using optical fiber based slow light techniques. - Continue the development of machine-vision algorithms and guidance strategies to enable the precision autonomous recovery of small sensor platforms on moving naval vessels. - Continue the development of an autonomous soaring capability and intelligent path planning for extracting energy from the environment thereby conserving onboard fuel stores of autonomous air vehicles. - Complete design and development of a disposable MAV which will enable the airborne delivery and precision placement of miniature EW sensors and payloads. - Complete the design of an advanced auto gyrator that combines a swashplateless rotor system and active stability augmentation for autonomous systems. Electronic Warfare: - Initiate development of an ultra-lean combustor for recuperated gas turbines. *FY 2010 Plans:* Electro Optic/Infrared: - Continue development of tunable narrowband infrared absorption technology. - Complete development of new processes/methodologies to enable construction of composite countermeasures that fit the engagement timeline while maintaining effectiveness against existing and emerging IR guided threats. Autonomous Systems: - Complete the development of a novel beam steering method in phased array radar using optical fiber based slow light techniques. - Complete the development of machine-vision algorithms and guidance strategies to enable the precision autonomous recovery of small sensor platforms on moving naval vessels.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Complete the development of an autonomous soaring capability and intelligent path planning for extracting energy from the environment thereby conserving onboard fuel stores of autonomous air vehicles. Electronic Warfare: - Continue all efforts of FY 2009.					
STRATEGIC SUSTAINMENT 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. The reduction from FY 2008 to FY 2009 is due to the completion of the Strategic System Infrastructure (SSI) program in FY 2008. *FY 2008 Accomplishments:* SSI: - Completed Missile propulsion efforts by conducting final testing. - Completed 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. - Completed Ordnance Initiation Technologies program by demonstrating and documenting new ordnance initiation technology that meets the requirements.		6.451	0.000	0.000	
STRIKE AND LITTORAL COMBAT TECHNOLOGIES The focus of this activity 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.		9.971	10.448	7.580	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

The net increase in funding between FY 2008 and FY 2009 is due to the realignment of efforts from the Navigation EO/IR activity and the planned reduction of funding for FNC efforts in this activity. Decrease from FY 2009 and FY 2010 is due to delay in start of Selectable Ouput Weapons and Mult-Target Laser Designator.

FY 2008 Accomplishments:

Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets:
- Initiated development of Weapons Data Link terminal to improve in-flight control of weapons in real time. Initial work will focus on research to improve RF amplification at high bandwidths and low-observable, high gain weapon mounted antennas.

Dynamic Target Engagement:
- Continued development of Decision Support System for dynamic target engagement.
- Continued development of remote sensor fusion hardware for ground sensors, an ultra endurance UAV, and a GMTI sensor for use on UAVs. (formerly funded in PE's 0602235N, 0603640M, and 0603114N)

Advanced Naval Fires Technology Spiral 1 (ANFT):
- Continued development of passive interferometric imaging system to detect millimeter wave RF anomalies within the background environment by using exotic signal processing techniques.

Increased Capability Against Moving and Stationary Targets:
- Continued development of passive interferometric imaging system to detect millimeter wave RF anomalies within the background environment by using exotic signal processing techniques.
- Completed IWS technology development.
- Completed genetic algorithm selection process for communication jamming.
- Initiated development of Direct Attack Seeker Head (DASH) by developing low cost multi-passive array technology using Imaging Infrared (IIR) and millimeter Wave (mmW) in a common aperture architecture.
- Initiated development of Multi-Mode Sensor/Seeker (MMSS) technology development to develop advanced signal processing techniques to classify and identify moving targets using Automatic Target Recognition (ATR).

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated the development of signal processing techniques to improve situational awareness and autonomous detection of hostile fire events in a dynamic urban clutter environment. Transferred to 0602271N - Initiated the development of techniques to combine current IR/EO technology and recent findings on the characteristics of the eye to classify and identify optical devices and individuals in real time at militarily significant ranges. Transferred to 0602271N - Initiated the development of a process to detect hostile camouflaged or hidden targets in shadows and diverse backgrounds of militarily challenging environments. Transferred to 0602271N				
FY 2009 Plans: Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets: - Continue development of Weapons Data Link terminal toward weapon scalability and modularity. Dynamic Target Engagement: - Complete development of Decision Support System for dynamic target engagement. Increased Capability Against Moving and Stationary Targets: - Complete the mmW component design for the DASH multi-sensor weapon seeker and begin the mmW sensor fabrication and testing. In conjunction with building the sensor suite of the Multi-mode Sensor/ Seeker, continue development of advanced signal processing techniques, which will classify and identify moving targets using Automatic Target Recognition (ATR). Enhanced Weapons Technologies: - Continue development of passive interferometric imaging system to detect millimeter wave RF anomalies within the background environment by using exotic signal processing techniques.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continue the development of signal processing techniques to improve situational awareness and autonomous detection of hostile fire events in a dynamic urban clutter environment. Transferred to 0602271N - Continue the development of techniques to combine current IR/EO technology and recent findings on the characteristics of the eye to classify and identify optical devices and individuals in real time at militarily significant ranges. Transferred to 0602271N - Continue the development of a process to detect hostile camouflaged or hidden targets in shadows and diverse backgrounds of militarily challenging environments. Transferred to 0602271N - Initiate three new products to expand current Counter Air / Counter Air Defense capabilities by providing improved range and end-game maneuverability while decreasing Time-of-Flight. Specific tasks to begin design and development phase are: Counter Air Advanced Medium-Range Air-to-Air Missile (AMRAAM) Improvements / Counter Air Defense Improvement / High Speed Components. - Initiate development and apply emerging technologies that support delivery of Technology Oversight Group approved FNC enabling capabilities structured to close operational capability gaps in power projection; package emerging power projection technologies into deliverable FNC products and ECs that can be integrated into acquisition programs within a five year period; and mature power projection technologies that support naval requirements identified within the Sea Strike and FORCEnet naval capability pillars. *FY 2010 Plans:* Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets: - Weapon Data Link project transitions to PE 0603114N. Increased Capability Against Moving and Stationary Targets: - Continue the Direct Attack Seeker Head (DASH) project by developing and testing of the radar sensor and procurement of the IIR sensor. - Continue the Multi-Mode Sensor/Seeker (MMSS) project. Enhanced Weapon Technologies: - Continue all efforts of FY 2009, less those noted as completed above.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Complete development of passive interferometric imaging system to detect millimeter wave RF anomalies within the background environment by using exotic signal processing techniques.					
WMD DETECTION The Chief of Naval Operations (CNO) in the Navy Strategic Plan (NSP) has directed that the Navy be able to combat Weapons of Mass Destruction (WMD) at sea and ashore. This activity addresses the development of key technologies for standoff detection of WMD's and component nuclear materials on ships at sea. The program will develop and demonstrate technology for actively detecting fissile material and other weapons of mass destruction. FY 2008 reflects the initiation of the WMD Detection Program. FY 2009 increase represents the ramping up of the program as continuing technological efforts evolve. The testing of the equipment in realistic maritime environments significantly increases the cost of testing. *FY 2008 Accomplishments:* - Initiated using particle beam (neutrons, gamma rays, muons, and others) to perform standoff detection of fissile material. - Initiated investigations into the use of Free Electron Laser (FEL) accelerator technologies for the detection of WMD's and nuclear components & materials. Conducted experiments to determine the ability of the FEL to perform remote detection of nuclear material on surfaces, and chemical biological agents in aerosol clouds. - Initiated development of hand-held and portable radiation detector technology to support maritime interdiction operations. - Initiated modeling and simulation efforts to determine the ability to use neutron activation analysis to locate smuggled nuclear weapons and material through underwater detection. *FY 2009 Plans:* - Continue all efforts of FY 2008.		6.069	8.094	9.913	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate planning for a maritime demonstration of standoff detection of fissile materials. This effort will involve formation of a team comprised of DoD, interagency, and international partners to support the demonstration. *FY 2010 Plans:* Weapons Mass Destruction Detection: - Continue all efforts of FY 2009.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH	PROJECT NUMBER 0000

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601152N/In-House Laboratory Independent Research									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602123N/Force Protection Applied Research									Continuing	Continuing
PE 0602131M/Marine Corps Landing Force Technology									Continuing	Continuing
PE 0602203F/Aerospace Propulsion									Continuing	Continuing
PE 0602235N/Common Picture Applied Research									Continuing	Continuing
PE 0602303A/Missile Technology									Continuing	Continuing
PE 0602601F/Space Technology									Continuing	Continuing
PE 0602602F/ Conventional Munitions									Continuing	Continuing
PE 0602618A/Ballistics Technology									Continuing	Continuing
PE 0602624A/Weapons and Munitions Technology									Continuing	Continuing
PE 0602702E/Tactical Technology									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602114N POWER PROJECTION APPLIED RESEARCH	PROJECT NUMBER 0000

PE 0603004A/Weapons and Munitions Advanced Technology		
PE 0603114N/Power Projection Advanced Technology	Continuing	Continuing
PE 0603216F/Aerospace Propulsion and Power Technology	Continuing	Continuing
PE 0603640M/USMC Advanced Technology Demonstration (ATD)	Continuing	Continuing
PE 0603739E/Advanced Electronics Technologies	Continuing	Continuing
PE 0603790N/ NATO Research and Development	Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

This PE develops early components technologies that if successful can be integrated into weapon systems that meet warfighter requirements. Most of the work in this PE can be classified between Technology Readiness Level (TRL) 2 (technology concept and/or application formulation) and TRL 4 (component and/or breadboard validation in laboratory environments). The metrics used to evaluate 6.2 programs are necessarily less precise than those used in 6.3 programs.

The metrics for this PE can be divided into two categories: technological and organizational/functional. Technological metrics address the success of the work performed. The primary technological metrics used in this PE involve laboratory experiments/tests demonstrating proof of the concept for the technology. This demonstration is frequently a hand-assembled functioning breadboard of the concept. The organizational/functional metrics applied to this PE include: transition of the technology to advanced development in a 6.3 PE and applicability of the technology to documented warfighter problems or requirements. Successful implementation of these categories would result in the application of a pass/fail metric and further evaluation for possible transition to a 6.3 development/demonstration program.

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	183.654	186.750	91.400						Continuing	Continuing
0000: FORCE PROTECTION APPLIED RESEARCH	183.654	186.750	91.400						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this program element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This 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. 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 Sea Shield, Sea Strike, Cross Pillar Enablers and Enterprise and Platform Enablers (EPE).

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

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	**R-1 ITEM NOMENCLATURE** PE 0602123N FORCE PROTECTION APPLIED RESEARCH

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	194.477	131.310	103.940	
Current BES/President's Budget	183.654	186.750	91.400	
Total Adjustments	-10.823	55.440	-12.540	
Congressional Program Reductions		-0.540		
Congressional Rescissions				
Total Congressional Increases		56.100		
Total Reprogrammings	-9.009			
SBIR/STTR Transfer	-1.814			
Program Adjustments			-11.568	
Rate/Misc Adjustments		-0.120	-0.972	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **ADVANCED SIMULATION TOOLS FOR AIRCRAFT STRUCTURES MADE OF COMPOSITE MATERIALS**	1.942	1.197
Project: 9999, **ALTERNATIVE ENERGY RESEARCH**	15.497	19.945
Project: 9999, **DEPUTEE-HIGH POWERED MICROWAVE NON-LETHAL VEHICLE/VESSEL ENGINE DISABLING**	0.000	1.596
Project: 9999, **FORCE PROTECTION APPLIED RESEARCH**	1.946	0.000
Project: 9999, **HARBOR SHIELD-HOMELAND DEFENSE PORT SECURITY INITIATIVE**	0.000	3.490
Project: 9999, **HIGH POWER DENSITY PROPULSION AND POWER FOR USSVS**	0.000	1.596
Project: 9999, **HIGH SPEED ACRC & COMPOSITES SEA LION CRAFT DEVELOPMENT**	0.000	1.995
Project: 9999, **HIGH STRENGTH WELDED STRUCTURES**	0.000	0.798
Project: 9999, **HIGH TEMPERATURE SUPER CONDUCTING MAGNETIC ENERGY STORAGE**	0.397	0.000
Project: 9999, **HIGH TOUGHNESS ALUMINUM STRUCTURES**	1.160	0.000
Project: 9999, **INTEGRATION OF ELECTRO-KINETIC WEAPONS INTO NEXT GENERATION OF NAVY SHIPS**	0.000	4.487
Project: 9999, **LITHIUM BATTERIES**	0.000	1.596
Project: 9999, **LITHIUM-ION CELL DEVELOPMENT WITH ELECTRO NANO MATERIALS**	2.901	3.988

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **LITHIUM-SULFUR CHEMISTRY VALIDATION FOR SONOBUOY APPLICATION**	0.000	1.596
Project: 9999, **MAGNETIC REFRIGERATION TECHNOLOGY**	3.088	2.394
Project: 9999, **MK V.1 MAKO FOR IMPROVED SIGNATURE AND WEIGHT PERFORMANCE**	0.967	1.995
Project: 9999, **NAVAL AVIATION TECHNOLOGY EXPLORATION INITIATIVE**	0.776	0.000
Project: 9999, **NAVAL SPECIAL WARFARE 11M RIB REPLACEMENT CRAFT DESIGN**	0.000	0.798
Project: 9999, **OPTICAL RECOGNITION PROTOCOL FOR BIOLOGICS DETECTION**	0.773	0.000
Project: 9999, **PLANAR SOLID OXIDE FUEL CELL SYSTEM DEMONSTRATION AT UTC SIMCENTER**	3.379	3.490
Project: 9999, **PMRF FORCE PROTECTION LAB**	1.946	1.995
Project: 9999, **SHIPBOARD PRODUCTION OF SYNTHETIC AVIATION FUEL**	1.547	0.997
Project: 9999, **SOLID OXIDE FUEL CELL**	0.000	0.798
Project: 9999, **STABLIZED LASER DESIGNATION CAPABILITY**	0.969	0.000
Project: 9999, **STANDOFF EXPLOSIVE DETECTION SYSTEM (SEDS)**	0.000	1.197
Project: 9999, **UNDERSEA PERIMETER SECURITY INTEGRATED DEFENSE ENVIRONMENT**	2.706	0.000

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH					PROJECT NUMBER 0000	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
0000: FORCE PROTECTION APPLIED RESEARCH	183.654	186.750	91.400						Continuing	Continuing

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 by virtue of improvements in platform offensive performance, stealth, and self defense. This effort supports the FNC in the areas of Sea Shield, Cross Pillar Enablers, and Enterprise and Platform Enablers (EPE).

This project reflects the alignment of Future Naval Capability (FNC)program investments for the following Enabling Capabilities (ECs): Fortified Position Security, Over-the-Horizon Missile Defense, Anti-Ship Missile Defense Technologies, Two-Torpedo Salvo Defense, Defense of Harbor and Near-Shore Naval Infrastructure Against Asymmetric Threats, Sea Based Missile Defense of Ships & Littoral Installations, Aircraft Integrated Self-Protection Suites, Advanced Threat Aircraft Countermeasures, Helicopter Low-Level Operation, Four Torpedo Salvo Defense, Shipboard Force Protection in Port and Restricted Waters - Detection and Classification, Underwater Total Ship Survivability, Compact Power Conversion Technologies, Affordable Submarine Propulsion and Control Actuation, and Advanced Electronic Sensor Systems for Missile Defense.

FY 2008 reflects the initiation of the Large Vessel Stopping Program in response to the Chief of Naval Operations' Navy Strategic Plan which specified that the Navy must combat Weapons of Mass Destruction (WMD) at sea and ashore. FY 2009 reflects the transfer of power conversion technologies for multi-function motor drives, bi-directional power conversion modules, and power management controllers from PE 0602236N/Cost Reduction Technologies.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
ADVANCED ENERGETICS	15.747	4.156	2.081	
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,				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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, and/or reduced-vulnerability systems tailored to specific warfighter missions. Decreased funding in FY 2009 is due to the conclusion and transition of Advanced Energetics efforts in the areas of enhanced performance formulations, insensitive explosives, detonation merging techniques, and reactive materials. Remaining funding will be used to complete transition efforts and to develop next generation concepts as described below. *FY 2008 Accomplishments:* - Continued Advanced Energetics research in technology development for the next generation reactive material warhead concepts (formulations, material properties, target interaction, lethality models, and experiments) for highly reactive materials, high density reactive materials and novel reactive structural materials. - Continued Advanced Energetics research in development and evaluation of advanced explosive/ propellant/reactive ingredients and formulations for next generation higher performing systems. - Continued Advanced Energetics research in development of advanced directed hydro-reactive material warhead concepts to enhance performance of undersea warheads. - Continued proof of concept efforts to develop insensitive explosives, propellants, and munitions without compromising performance. This work involves development of high quality, small particle energetic ingredients, novel processing techniques, and advanced energy conversion concepts; and involves both theoretical and experimental efforts. - Continued Advanced Energetics research in advanced multiphase blast concepts employing dense metalized explosives to enhance performance of air and underwater blast warheads. - Continued Advanced Energetics research in development and diagnostics of novel energy conversion concepts to enhance performance, more efficiently exploit available energy, and more effectively couple energy to target for air, surface, and underwater warhead application.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2009 Plans: - Continue research in technology development for the next generation reactive material warhead concepts (formulations, material properties, and energy release experiments) for highly reactive materials, high density reactive materials and novel reactive structural materials. Transition application specific target interaction, lethality modeling and ordnance specific experiments and demonstrations to Electro-magnetic Rail Gun, PE 0603114N. - Continue development of novel energy conversion concepts to enhance performance, more efficiently exploit available energy, and more effectively couple energy to target. Limit efforts to analytical and laboratory scale proof of concept experimental efforts. - Continue development and evaluation of energetic ingredients and formulations for next generation higher performance applications. Conclude scale-up development and testing. Transition to Integrated High Payoff Rocket Propellant Program, PE 0602114N. - Complete proof of concept efforts to develop insensitive explosives, propellants, and munitions without compromising performance. Transition to Future Naval Capabilities Program. - Complete development of and transition directed hydro-reactive material warhead concepts to Undersea Warheads Program, PE 0602747N. - Complete research in advanced multiphase blast concepts employing dense metalized explosives to enhance performance of air and underwater blast warheads. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above.					
AIRCRAFT TECHNOLOGY The Aircraft Technology activity develops technologies for survivability and reduced observability, metrics are classified. It also develops new Naval air vehicle concepts and high impact, scaleable naval air vehicle technologies, such as - autonomous air vehicle command and control, helicopter and tiltrotor rotor and drive systems, aerodynamics, structures and flight controls for future and legacy air vehicles, which significantly increase the naval warfighter's capabilities, effectiveness, readiness, and safety, while reducing life cycle cost. This activity directly supports the Naval Aviation Enterprise Science and		16.241	15.639	12.749	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Technology Objectives and the Naval Science and Technology Strategic Plan, principally in the Platform Mobility Focus Area. The FY 2009 to FY 2010 decrease is due to the reduced level of investment. *FY 2008 Accomplishments:* - Continued development of survivability/reduced observables technology. Metrics are classified. - Continued development of flight control, intelligent autonomy, command & control, and multi-vehicle cooperation technologies for UAV. - Continued development of a Computational Fluid Dynamics (CFD) based integration system to maximize operational capability of autonomous aircraft by choosing optimal flight pattern for any environmental condition including low speed operations and brownout. - Continued vertical lift technology investments. - Completed 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. - Completed development effort to control flow and thermal dynamics in particle coating process and densification dynamics of large windows. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Initiate research in fixed wing aircraft/vertical lift/rotorcraft technology areas such as aeromechanics, propulsion, active rotor control for enhanced ship board operations, structural concepts compatible with shipboard operations, autonomous operations in the shipboard and austere environment, and innovative vehicle concepts for naval application. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Initiate research in vertical lift aircraft /rotorcraft technology areas such as aeromechanics, propulsion, active rotor control for enhanced ship board operations, structural concepts compatible with shipboard				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
operations, autonomous operations in the shipboard and austere environment, and innovative vehicle concepts for naval application.					
FLEET FORCE PROTECTION AND DEFENSE AGAINST UNDERSEA THREATS 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 and to develop the capability to interdict underwater asymmetric threats to ships and infrastructure in harbors. Current small platforms (both surface and airborne) have little to no situational awareness (SA) or self-protection against air, surface, and asymmetric threats. (Asymmetric threat efforts are co-funded by PE 0602131M.) 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 (EO, IR, RF, EM, visual, and acoustic), or chemical 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 activity is to develop a torpedo defense capability to fill Sea Shield Warfighting Capability Gap/Enabling Capability: Platform Defense against Undersea Threats, including Four 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. This activity supports the Fleet and Force Protection FNC and includes support to Sea Shield and Sea Strike Pillars and FNC Enabling Capabilities for: Aircraft Integrated Self-protection Suite; Fortified Position Security; Advanced Electronic Sensor Systems for Missile Defense; and Shipboard Force Protection in Port and Restricted Waters - Detection and Classification. Budget Activity 2 sensor efforts are co-funded by PEs 0602235N and 0602271N. *FY 2008 Accomplishments:* Sensors & Associated Processing		13.514	13.297	12.095	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued efforts in biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing algorithms. - Continued design and fabrication of microfluidic nucleic acid extraction and enrichment methods and obtained funding for technology transfer. - Continued efforts in biomimetic signal processing: panoramic periscope for submarines and temporal pattern recognition for Systems for Security Breaching Noise Detection. - Continued efforts in bioinspired quiet, efficient and maneuverable self-propelled line array using high-lift propulsors based on insect biomechanics. - Continued the development of low-cost, lightweight radar absorbing material (RAM) based on metallized cellulose in the form of fibers, fabric and paper. - Continued design and testing of on-chip nucleic acid amplification and transfer technology. - Continued studies to develop catalytic activity profile of bioactive coatings against chemical agents. Designed and initiated fabrication of coatings to degrade both, chemical and biological agents. - Continued advanced concept development to integrate object recognition and tracking algorithms, machine vision, multiple networked video streams into different classes of EO/IR sensors within the Intelligent Video Surveillance FNC product (transferred from PE 0602131M). - Continued design and fabrication of self-reporting coatings for system failure detection. - Completed the End User Terminal (EUT) effort by developing a prototype 2-way amplifier for the Secure Net (SECNET) 11 card that will increase by a factor of 9 the secure transmit/receive range between Dismounted-Data Automated Communications Terminals (D-DACT) in an urban environment. - Completed the Integrated EO/IR Self Protect Suite for Rotary Wing Aircraft by conducting a laboratory demonstration of the integrated Missile Warning Sensor (MWS) and multi-band fiber coupled laser jammer. - Completed development of solid projectile coilgun design, consumable casing material and improved railgun efficiency and developed method of reducing muzzle flash and surface wear of the rails. - Completed the design and development of integrated laser ground based, aircraft protection design to protect large aircraft from Infrared SAMs upon ingress and egress to an airport. - Completed the Intelligent Video Surveillance project including integration of object recognition and tracking algorithms, machine vision, and multiple networked video streams into different classes of EO/IR sensors.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Completed development of compact sensor systems in support of responsive Intelligence, Surveillance, and Reconnaissance (ISR). - Completed efforts on Antibodies for biowarfare agents to 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. - Completed design and development of large (1.5m dia.) telescopes with associated adaptive optics for the Naval Prototype Optical Interferometer (NPOI). - Completed development of a 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. - Completed integration of DNA and antibody array analysis and demonstrated capability for rapid screening and pathogen species confirmation. - Transferred biomimetic signal processing efforts, including panoramic periscope and temporal pattern recognition for security breaching noise detection to PE 0602236N. - Transferred efforts in bioinspired quiet, and maneuverable self-propelled line array using high-lift propulsors based on insect biomechanics to PE 0602236N. - Transferred efforts in biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing algorithms to PE 0602236N. - Initiated new FNC EC Shipboard Force Protection in Port and Restricted Waters - Detection and Classification. This project will develop mission specific electro-optic/infrared sensors to detect, classify, and determine the intent of potential terrorist and special operations force threats to ships and craft inport and transiting restricted waters. Underwater Platform Self-Defense - Completed the scalable low frequency continuous wave acoustic weapon for use against underwater asymmetric threats. - Initiated development of low-cost, light weight swimmer detection and localization technologies. - Initiated development of optimized microfluidic components suitable for explosive, chemical, and biological sensing applications, and initiate the development of models required to apply existing automated design tools to components with more complex physics and more general geometries.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2009 Plans: Sensors & Associated Processing - Continue all efforts of FY 2008, less those noted as completed above. - Complete the development of low-cost, lightweight RAM based on metallized cellulose in the form of fibers, fabric and paper. - Initiate the Countermeasures for Advanced Imaging Infrared (IIR) Guided Missiles FNC effort by initiating IIR threat model development. - Initiate the Countermeasures for Millimeter Wave Guided Missiles FNC effort by initiating requirements analysis. - Initiate the Multifunction Capabilities for Missile Warning Sensors FNC effort by commencing data collection and analysis. - Initiate efforts to design microfabricated system for 3-color fluorescence measurements using integrated waveguides. - Initiate effort to develop new, highly selective, preferential oxidation catalysts for the generation of power from the reformate gas purification process. - Initiate effort to develop aspheric gradient index optics. - Initiate the Helicopter Laser-Based Landing Aids FNC effort by commencing experimentation, data collection and analysis. Underwater Platform Self-Defense - Continue all efforts of FY 2008, less those noted as completed above. - Continue development of low-cost, light weight swimmer detection and localization technologies. - Initiate development of software encoded algorithms for the Anti-Torpedo Torpedo (ATT) sensor and controller that will enable ATT's to successfully engage torpedo salvoes of up to four attacking units. *FY 2010 Plans:* Sensors & Associated Processing - Continue all efforts of FY 2009, less those noted as completed above. Underwater Platform Self-Defense				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continue all efforts of FY 2009.				
MISSILE DEFENSE (MD) This activity describes Missile Defense S&T projects of the Sea Shield FNC program, and non-FNC-related Navy research. - 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. To be completed in FY 2009 with funding in PE 0603123N, the metric for AADI is execution of an ADSAM demonstration by the Navy and Marine Corps that establishes the basis for further development of an operational Naval Integrated Fire Control/Counter-Air (NIFC-CA) capability. - Naval Interceptor Improvements (NII) technology upgrades for STANDARD Missile (SM) future fleet air defense missile. Metrics will be to achieve SM performance requirements in specified tactical rain environments and achieve SM performance requirements in all specified electronic countermeasures environments. - Extended Distributed Weapons Coordination (EDWC) algorithms to extend DWC ABMA functionality to include coordination of passive defense measures (emission control, use of decoys, maneuvering). Metric will be improved probability of negation (Pneg) against advanced ballistic & cruise missile anti-ship threats that may be susceptible to decoys and jamming. - Positive Control of Naval Weapons (PCNW) - additional technology upgrades for SM to enable forward relay, remote launch & potentially forward pass engagements. Metrics are classified. - Midcourse and Terminal Algorithms (MTA) for interceptor and associated weapon system enhancements to defeat anti-ship ballistic missile (ASBM) threats with high confidence while retaining or improving baseline capability against advanced anti-ship cruise missiles (ASCM). Specific metrics are classified. - Enhanced Lethality Guidance Algorithms (ELGA) to increase probability of kill versus an expanded threat set including ASBMs and advanced ASCMs. Metrics for this project will be classified. - Enhanced Maneuverability Missile Airframe (EMMA) technology for Navy shipboard missile systems to intercept highly agile maneuvering ASCMs and ASBMs. Metrics for this project will be classified. - Emerging technologies that support delivery of Navy approved FNC enabling capabilities (EC) structured to address operational capability gaps in air and missile defense.	14.280	13.100	11.103	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Non-FNC-related investigation of effects of charged particle layers on UHF to S-Band radars used to track space vehicles and initiate development of advanced electromagnetic decoy launchers and payloads. The FY 2008 - FY 2009 decrease represents the phased movement of EDWC, PCNW, and NII projects from Applied Research (6.2) to Advanced (6.3) Research as the technologies mature and prepare for acquisition. *FY 2008 Accomplishments:* - Continued program to investigate effects of charged particle layers on UHF to S-Band radars used to track space vehicles. - Completed additional AADI S&T planning and coordination for the FY 2009 Navy ADSAM live-fire demonstration taking place under PE 0603123N. - Continued NII project. - Initiated EDWC and PCNW efforts. *FY 2009 Plans:* - Continue all efforts, less those noted as completed above. - Initiate MTA project efforts. - Initiate development of advanced electromagnetic decoy launchers and payloads. (NRL) *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete EDWC, NII and PCNW development efforts that will be tested/demonstrated. - Initiate ELGA and EMMA project efforts.				
STOPPAGE OF LARGE SURFACE VESSELS AT SEA The Chief of Naval Operations (CNO) in the Navy Strategic Plan (NSP) has specified that the Navy must combat Weapons of Mass Destruction (WMD) at sea and ashore. To support this requirement, the Navy must be able to temporarily stop ships that are suspected of carrying WMDs or their component materials. This activity addresses the development of key technologies that will enable the Navy to use non-lethal	5.780	7.560	9.521	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
methods for temporarily stopping and delaying non-cooperative large, greater than 20 meters or 300 gross tons, vessels at sea that will not comply with voice commands or warning devices. The technologies will be deployable by ship or aircraft and should be capable of disabling the vessel at safe distances from high-valued assets and infrastructures. Funding increase from FY 2008 to FY 2009 is due to the natural growth of the program as technology development efforts increase. Funding increase from FY 2009 - FY 2010 is due to large-scale demonstrations of various systems. *FY 2008 Accomplishments:* - Initiated evaluation of potential propeller entanglement device materials. - Initiated propulsion drive-train damage predictions. - Initiated assessment of delivery options for a large linear propeller entanglement device. - Initiated a component level proof of concept demonstration for externally inhibiting seawater cooling flow to ship propulsion equipment. - Initiated the identification and assessment of potential commercial maritime vessel electronic vulnerabilities within representative propulsion and maneuvering control systems. - Initiated a scaled component level proof of concept demonstration for a large vessel momentum reduction concept and determine the feasibility of seaborne or airborne delivery of a prototype system. *FY 2009 Plans:* - Continue all efforts of FY 2008. - Complete evaluation of potential propeller entanglement device materials. - Complete propulsion drive-train damage predictions. - Complete assessment of delivery options for a large linear propeller entanglement device. - Complete component level proof-of-concept demonstration for externally inhibiting seawater cooling flow to ship propulsion equipment. - Complete the identification and assessment of potential commercial maritime vessel electronic vulnerabilities within representative propulsion and maneuvering control systems.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete scaled component level proof-of-concept testing for large vessel momentum reduction concept. - Initiate prototype development and fabrication for a full-scale propeller entanglement device. - Initiate design and fabrication of device and emplacement system to externally inhibit seawater cooling flow to ship propulsion equipment. - Initiate the evaluation of technologies capable of remotely exploiting the electronic vulnerabilities identified within critical propulsion and steering systems. - Initiate the design and evaluation of a full-scale large vessel momentum reduction device and delivery system. - Initiate tactical system engineering and define the operational parameters for a large vessel momentum reduction device. - Initiate analysis and modeling of hydrodynamic forces generated between a large vessel and much smaller intercept craft or Unmanned Surface Vehicle (USV). *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete prototype development and fabrication for a full-scale propeller entanglement device. - Complete design and fabrication of device and emplacement system to externally inhibit seawater cooling flow to ship propulsion equipment. - Complete the evaluation of technologies capable of remotely exploiting the electronic vulnerabilities identified within critical propulsion and steering systems. - Complete the design and evaluation of a full-scale large vessel momentum reduction device and delivery system. - Complete tactical system engineering and define the operational parameters for a large vessel momentum reduction device. - Initiate full-scale demonstration of propeller entanglement prototype. - Initiate development of a USV delivery capability for a device emplacement package to externally inhibit seawater cooling flow to ship propulsion equipment. - Initiate development of an autonomous delivery and deployment capability for a device emplacement package to externally inhibit seawater cooling flow to ship propulsion equipment.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate test and evaluation of delivery systems for technologies capable of remotely exploiting the electronic vulnerabilities identified within critical propulsion and steering systems. - Initiate design and fabrication of a full-scale system capable of remotely exploiting the electronic vulnerabilities identified within critical propulsion and steering systems. - Initiate fabrication of a full-scale demonstration system for a large vessel momentum reduction device.					
SURFACE SHIP & SUBMARINE HULL MECHANIC & ELECTRICAL (HM&E) Efforts include: signature reduction, hull life assurance, hydromechanics, distributed control for automated survivability (includes damage control), 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 control of systems utilizing self-healing capability. Advanced electrical power systems efforts address electrical and auxiliary system and component technology to provide improvement in energy and power density, operating efficiency and recoverability from casualties. Advanced Naval Power efforts include: Compact Power Conversion Technologies that reduce the cost of high power conversion equipment required to enable more-electric and all-electric ships. This activity also supports Global War on Terror (GWOT) Counter IED – Extramural activity which supports applied research for force protection of Naval platforms. Technologies are being developed that focus on prediction, prevention, detection, neutralization, and mitigation of improvised explosive devices in the maritime/littoral environment. The funding decrease from FY 2009 to FY 2010 is due to the current completion of the following Energy and Power efforts: Distribution/Control and Alternative Energy efforts, Energy Storage and Power Generation efforts and the Medium Voltage Direct Current (MVDC) architecture efforts in support of the Next Generation Integrated Power System (NGIPS) Roadmap efforts. The decrease also represents the phased movement of Future Naval Capability Enabling Capabilities Compact Power Conversion		78.098	77.050	43.851	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Technologies from Applied (6.2) to Advanced (6.3) Research as the technologies mature and prepare for transition to acquisition. *FY 2008 Accomplishments:* Survivable Platforms - Reduced Signatures - Continued advanced numerical acoustic codes (and gridding methods for those codes) for submarines. - Continued mmWave Signatures measurement to identify key signature characteristics. - Continued Alternating Current (AC) propagation experiments. - 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 development of quiet control surface design tool based on control surface flow noise studies. - Continued IR and radar detectability prediction capability. - Continued surface ship super-conductive degaussing with laboratory demonstration loop for Electromagnetic (EM) field accuracy measurements and control methods. - Continued testing on Advanced Electric Ship Demonstrator (AESD) to assess energy propagation and acoustic radiation mechanisms and to develop mitigation concepts for surface ships. - Continued IR assessment of two advanced treatments. - Continued first of a series of IR validation experiments and critical sensitivity analysis. - Continued Improved Corrosion Related Magnetic (CRM) Field Prediction Model to design compensation systems to reduce ship's CRM signature. - Continued assessment of ship bistatic Radar Cross Section (RCS). - Continued large-scale tests on AESD to develop signature prediction and design tools for surface ship incorporating a variety of propulsion technologies including external podded propulsion. - Continued experimental effort to characterize electric drive motor signature mechanisms and verify modeling and simulation approaches for signature prediction. - Completed hull machinery noise measurements. - Completed development of test vessel and technology to evaluate performance and signature associated with electrically driven waterjets (AWJ-21) and Rim-drive motor (RIMJET).				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Completed modeling of electric warship components and system electromagnetic signatures with electric motor source control through motor configuration, off ship EM field control through compensation and investigation of other sources of EM fields. - Initiated development of modeling methods and noise control concepts for modular/reconfigurable submarine architectures. - Initiated investigation into hull treatment concepts for acoustic signature/vibration control for surface ships. - Initiated development of advanced RF metamaterials for platform signature control. - Initiated development of LPI technologies for surface ship emissions including communication, navigation, electronic warfare, and combat systems. Survivable Platforms - Hull Life Assurance - Continued development of global surface wave measurement capability for ship models. - Continued Dynamic Behavior of Composite Ship Structures (DYCOSS) (joint effort with Dutch Navy). - Continued development of structural analysis codes describing failure mechanism of sandwich composites. - Continued Explosion Resistant Coatings (ERC) effort, providing US input to trilateral agreement with UK and Australia. - Continued Joint US/Japan Advanced Hull Materials & Structures Technology (AHM&ST) addressing hybrid hull concept and hybrid (steel/composite) joints in ship construction. - Continued composite and composite-metal hull performance characterization and testing including structural loading, thermal stress and signatures. - Continued effort on an advanced class of polymers as a follow-on to current ERC for application against advanced threats (GWOT). - Initiated Payload Implosion and Platform Damage Avoidance efforts. - Initiated development of reliability-based recoverability methods for assessing damaged ship structures. Survivable Platforms - Distributed Intelligence for Automated Survivability - Continued development of modeling and simulation methods for robust design and virtual testing of integration of shipboard auxiliary systems including their control systems.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued research into advanced HM&E system reconfiguration approaches, including agent-based control systems and algorithms, and model-based reasoning. Advanced Platforms - Advanced Platform Concepts and Designs - Continued validation of asymmetric hull forms with experimental data. - Continued development of analytical models to further define submarine modular hull concepts. - Continued development of reliability based design and structural analysis code development. - Continued development design tools for integrated antenna and composite topside. - Continued circulation control analysis for three-dimensional flow effects. - Continued aperstructures microwave communication system. - Continued concept for Ultra High Frequency (UHF)/Very High Frequency (VHF) aperstructures opportunistic array (Advanced Hull-form Inshore Demonstrator - AHFID). - Initiated development of methods for determining reliability and vulnerability of aluminum ship structures. Advanced Platforms - Hydromechanics - Continued experimental database/computational tools development for extreme submarine maneuvers (e.g., crashback). - Continued the validation of circulation control and advanced control surfaces with experiments. - Continued to investigate improved maneuvering simulation capability for submarines. - Continued validation of Reynolds Average Navier-Stokes (RANS) code for advanced waterjet propulsor performance predictions. - Continued development of two-phase flow waterjet concept, Detached Eddy Simulation (DES) method for crashback prediction and numerical prediction method(s) of waterjet cavitation. - Continued modeling of turbulent flow interaction with propeller Leading Edge (LE) and Trailing Edge (TE) and modeling and simulation of rough-wall boundary layer noise. - Continued development of podded propulsor design/analysis tools. - Completed prediction and validation of constrained capsize motions using advanced codes. - Completed prediction and validation of unconstrained capsize using advanced codes. - Initiated prediction and validation of damaged stability and capsize. - Initiated non-body-of-revolution tool development for advanced submarine configurations.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated the multi-platform interaction analysis and tool development. Advanced Naval Power Systems - Continued demonstration of dynamic stability of an advanced intelligent, reconfigurable, solid-state-based, zonal-electrical power system that reconfigures within 10 milliseconds. - Continued designing software for the system manager for the Universal Control Architecture (UCA). - Continued development of thermal management technology for shipboard power distribution. - Continued investigation of potential applications of silicon-carbide in future high voltage and high power applications. - Continued improvements in electrical component and device technology allowing a reduction in motor propulsion and motor controllers weight and volume. - Continued development of technologies to support dynamic reconfiguration of shipboard systems under conditions of stressing scenarios and/or system degradation. - Continued multi-year program to directly convert thermal energy to electricity. Such a capability would allow elimination of the steam cycle on an electric warship. - Continued studies of alternative cooling systems for future shipboard radar systems. - Continued development of structural macroscopic 3-dimensional battery. - Continued development of pulsed power technologies to include pulsed alternators and capacitors. - Continued electromechanical actuator noise source characterization activities. - Continued torque measurements on reduced scale models in support of electromechanical actuators. - Continued control surface actuator project focused on the technologies needed to define the design space for control surface actuators supporting submarines. - Continued development of automated HVAC system architectures for future Naval platforms. - Continued development of common universal stator design to accommodate varying rotor topologies to improve affordability of motor design and development. - Continued ship service fuel cell development. - Completed studies of the thermal performance and reliability of two-phase pumped cooling loops. - Completed research into high power controller and generator applications by using mixed winding, high-phase-order induction machines actuated with multi-phase and multi-level inverters and rectifiers. - Initiated development of shipboard waste heat driven chiller systems.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated program to develop and demonstrate 3 - 50 kW class solid oxide fuel cell onboard mobile power generation capabilities having compatibility with future logistics fuels to enable rapid recharge of batteries and direct power for C4ISR equipment. Surface Ship & Submarine HM&E Applied Research - Continued technology development for alternate approaches to high voltage fast turn off switches. - Continued development of heterojunction power switching devices. - Completed Biofilms on Scaffolds and Characterize Spatial Distribution and Chemistries. - Completed High Surface Area Conducting Electrodes for use as Biofilm Scaffolds. - Completed technology development for wafer bonded high voltage power switches. - Completed efforts to synthesize new metal sulfides as catalysts for fuel cells and evaluate their electrochemical performance. - Completed technology development for alternate approaches to high voltage fast turn off switches. - Initiated the computational design, synthesis and evaluation of new, high capacity, high-rate anode materials for Li-ion batteries. *FY 2009 Plans:* Survivable Platforms - Reduced Signatures - Continue all efforts of FY 2008, less those noted as completed above. - Complete testing on AESD to assess energy propagation and acoustic radiation mechanisms and to develop hull treatment concepts for surface ships. - Complete experimental effort to characterize electric drive motor signature mechanisms and verify modeling and simulation approaches for signature prediction. - Complete CRM Field Prediction Model with final validation by measurement of full scale ship to verify CRM Field Prediction against actual Impressed Current Cathodic Protection (ICCP) system layout for measured ship and magnetic/electric fields measured at Navy Magnetic Silencing Range Facility. - Initiate development of signature modeling approaches for electric actuation and alternate electric drive system architectures. - Initiate development of Low probability Intercept (LPI) technologies for surface ship emissions including communication, navigation, electronic warfare, and combat systems.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Survivable Platforms - Hull Life Assurance - Continue all efforts of FY 2008. Survivable Platforms - Distributed Intelligence for Automated Survivability - Continue all efforts of FY 2008. - Initiate Second Generation distributed systems model development. - Initiate demonstration of real-time modeling of multiple distributed systems – utilizing small scale demonstrator. - Initiate demonstration of Genetic Algorithm(s) for determining optimal distributed system control strategy. - Initiate development of a hardware in-the-loop small scale demonstrator for fluid/thermal/electrical distributed systems. - Initiate development of Survivability Analysis Algorithms Operable on a Total Ship Modeling Environment. Advanced Platforms - Advanced Platform Concepts and Designs - Continue all efforts of FY 2008. Advanced Platforms - Hydromechanics - Continue all efforts of FY 2008, less those noted as completed above. - Complete development of two-phase flow waterjet concept. - Complete prediction and validation of unconstrained capsize using advanced codes. Advanced Naval Power Systems - Continue all efforts of FY 2008, less those noted as completed above. - Continue analytical model and reduced scale component development of power conversion technologies for multi-function motor drives, bi-directional power conversion modules, and power management controllers focusing on closing technology gaps associated with Alternative Integrated Power System (IPS) Architectures. (Transitioned from PE 0602236N/Cost Reduction Technologies)				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete demonstrations of improvements in electrical component and device enabling technology allowing a reduction in motor propulsion and motor controllers weight and volume. - Complete demonstration of Ship and Submarine Electric Actuator basic technology. - Complete studies of alternative cooling systems for future shipboard radar systems. - Complete multi-year program to directly convert thermal energy to electricity. - Complete development of structural macroscopic 3-dimensional battery. - Complete development of pulsed power technologies to include pulsed alternators and capacitors. - Complete energy storage, thermal management, electromechanical machines program under the Energy-Power Technology Initiative. - Initiate preliminary designs of control surface actuator systems. - Initiate studies of advanced heating, ventilation, and air-conditioning architectures, including studies of alternative (non-vapor-compression) refrigeration systems and concepts for waste heat reuse, to enhance ship cooling and provide thermal energy storage. - Initiate research into the development of fuel chemistries, materials, and energy conversion technologies for optimal performance in Naval power systems. Surface Ship & Submarine HM&E Applied Research - Continue all efforts of FY 2008, less those noted as completed above. *FY 2010 Plans:* Survivable Platforms - Reduced Signatures - Continue all efforts of FY 2009, less those noted as completed above. - Complete mmWave Signatures assessments to identify key signature characteristics. - Complete IR validation experiments and critical sensitivity analysis. - Complete testing on AESD to develop hull treatment coverage prediction capability for surface ships. - Initiate development of advanced special materials for hemispherical signature control. - Initiate scientific study of advanced passive EM signature control technologies. - Initiate development of next generation of evolving threat sensor systems. Survivable Platforms - Hull Life Assurance				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continue all efforts of FY 2009. Survivable Platforms - Distributed Intelligence for Automated Survivability - Continue all efforts of FY 2009. - Complete development of a hardware in-the-loop small scale demonstrator for fluid/thermal/electrical distributed systems. Advanced Platforms - Advanced Platform Concepts and Designs - Continue all efforts of FY 2009. Advanced Platforms - Hydromechanics - Continue all efforts of FY 2009, less those noted as completed above. - Initiate full-scale circulation control bow planes design and construction for at-sea test. - Initiate prediction and validation of damaged stability and capsize for advanced hulls and codes. Advanced Naval Power Systems - Continue all efforts of FY 2009, less those noted as completed above. - Complete preliminary designs of control surface actuator systems. - Complete common universal stator design to accommodate varying rotor topologies to improve affordability of motor design and development. - Initiate detailed design and breadboard demonstration of control surface actuator systems. Surface Ship & Submarine HM&E Applied Research - Continue all efforts of FY 2009. - Complete development of heterojunction power switching devices. - Complete the computational design, synthesis and evaluation of new, high capacity, high-rate anode materials for Li-ion batteries.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0204152N/E-2 Squadrons									Continuing	Continuing
PE 0205601N/HARM Improvement									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602000D8Z/Joint Munitions Technology									Continuing	Continuing
PE 0602114N/Power Projection Applied Research									Continuing	Continuing
PE 0602131M/Marine Corps Landing Force Technology									Continuing	Continuing
PE 0602204F/Aerospace Sensors									Continuing	Continuing
PE 0602235N/Common Picture Applied Research									Continuing	Continuing
PE 0602270A/Electronic Warfare Technology									Continuing	Continuing
PE 0602271N/ Electromagnetic Systems Applied Research									Continuing	Continuing
PE 0602747N/Undersea Warfare Applied Research									Continuing	Continuing
PE 0603114N/Power Projection Advanced Technology									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000	
PE 0603123N/Force Protection Advanced Technology		Continuing	Continuing
PE 0603235N/Common Picture Advanced Technology		Continuing	Continuing
PE 0603271N/ Electromagnetic Systems Advanced Technology		Continuing	Continuing
PE 0603502N/Surface and Shallow Water Mine Countermeasures		Continuing	Continuing
PE 0603513N/Shipboard System Component Development		Continuing	Continuing
PE 0603553N/Surface ASW		Continuing	Continuing
PE 0603561N/Advanced Submarine System Development		Continuing	Continuing
PE 0603609N/ Conventional Munitions		Continuing	Continuing
PE 0603640M/USMC Advanced Technology Demonstration (ATD)		Continuing	Continuing
PE 0604307N/Surface Combatant Combat System Engineering		Continuing	Continuing
PE 0604518N/Combat Information Center Conversion		Continuing	Continuing
		Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602123N FORCE PROTECTION APPLIED RESEARCH	PROJECT NUMBER 0000

PE 0604558N/New Design SSN		
PE 0604561N/SSN-21 Developments	Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

This PE supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial and air) and the protection of those platforms. Each PE Activity has unique goals and metrics, some of which include classified quantitative measurements. Overall metric goals are focused on achieving sufficient improvement in component or system capability such that the 6.2 applied research projects meet the need of or produce a demand for inclusion in advanced technology that may lead to incorporation into acquisition programs or industry products available to acquisition programs.

Specific examples of metrics under this PE include:
- Provide improvements in electrical component and device technology as to allow a 50% reduction in motor propulsion and motor controllers weight and volume by FY 2009.
- Increase the hydrodynamic efficiency of current hull designs by 5% by FY 2010.
- Reduce electromagnetic vulnerability of ship hulls by 50% by FY 2011.
- Torpedo defense thresholds will be validated by modeling and simulation to satisfy the overall system performance specification of a Probability of Survival (PS) of the US Navy platform as specified in the draft Capabilities Development Document (CDD) for Surface Ship Torpedo Defense.
- Additional metrics are included within the Missile Defense Activity description.

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	31.258	42.858	39.308						Continuing	Continuing
3001: MARINE CORPS LANDING FORCE TECHNOLOGY	31.258	42.858	39.308						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval Science and Technology (S&T) Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE is organized into nine activities which are represented as seven Expeditionary Warfighting Capability Areas, as well as Future Concepts, Technology Assessment and Roadmapping, and the Littoral Combat/Power Projection (LC/PP) FNC. 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 Expeditionary Maneuver Warfare. This PE provides the knowledge base to support Advanced Technology Development (6.3) and is the technology base for future expeditionary warfare capabilities. This PE supports the Expeditionary Force Development System of the Marine Corps Combat Development Command (MCCDC) and responds directly to the Marine Corps Science and Technology (S&T) process as well as supporting related Littoral and Expeditionary Maneuver Warfare capabilities developed by the Navy's Mission Capability Program. The Future Naval Capabilities (FNC) process is supported and funds are programmed accordingly. The FNC program explores and demonstrates technologies that enable Sea Strike, Sea Shield, Sea Basing and FORCEnet pillars. The core 6.2 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 the Sea Power 21 Pillars, as well as enable Ship to Objective Maneuver (STOM), Persistent Intelligence, Surveillance and Reconnaissance and Overseas Contingency Operations (OCO).

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

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	**R-1 ITEM NOMENCLATURE** PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	31.813	36.480	39.858	
Current BES/President's Budget	31.258	42.858	39.308	
Total Adjustments	-0.555	6.378	-0.550	
Congressional Program Reductions		-0.116		
Congressional Rescissions				
Total Congressional Increases		6.500		
Total Reprogrammings	-0.257			
SBIR/STTR Transfer	-0.298			
Program Adjustments			-0.574	
Rate/Misc Adjustments		-0.006	0.024	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **HIGH POWER LIGHTWEIGHT ZINC-AIR BATTERY**	0.965	2.493
Project: 9999, **SURVIVABILITY PROGRAM**	1.447	0.000
Project: 9999, **WARFIGHTER RAPID AWARENESS PROCESSING TECHNOLOGY**	2.891	3.989

Change Summary Explanation

Technical: FY 2009 and out reflects funding for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems to meet the imposing security threats that challenge our Nation, and it may not be adequately postured to take advantage of key scientific and technological opportunities that offer breakthrough advantages to our warfighters. This broad, multi-year (through the FYDP) initiative will expand existing technology integration and increase/spur the application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes; therefore, funding associated with this DoD initiative is reflected throughout the PE.

In FY 2010 preparation efforts continue in areas of technology that are ready for major, integrated technology demonstration. All technical work is being coordinated throughout DoD on these demonstrations. In areas such as vehicle technology demonstrations, the goal is to deliver multiple classes of advanced technology ground vehicle demonstrations leading to new classes of protective, efficient, ground vehicles.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY					PROJECT NUMBER 3001	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
3001: MARINE CORPS LANDING FORCE TECHNOLOGY	31.258	42.858	39.308						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project is organized into nine activities which are represented as seven Expeditionary Warfighting Capability Areas, as well as Future Concepts; Technology Assessment and Roadmapping; and the Littoral Combat/Power Projection (LC/PP) FNC. The seven Expeditionary Warfighting Areas support the Discovery and Invention (D&I) and the Innovation and Transformation (I&T) investment. The LC/PP FNC supports the Exploitation and Deployment (E&D) investment.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
COMMAND, CONTROL, COMMUNICATIONS, AND COMPUTERS (C4)	0.000	2.994	3.342	
This activity supports S&T investment in Command and Control and is focused in three main areas. (1) Implementing the FORCEnet concept. FORCEnet is the operational construct and architectural framework for naval warfare in the information age that integrates warriors, networks, command and control, and weapons into a networked, distributed, combat force that is scalable across all levels of conflict from the seabed to space and sea to land. The Marine Corps instantiation of FORCEnet is Marine Air Ground Task Force Command and Control (MAGTF C2), with technologies to exchange data and information with and among distributed tactical forces. (2) Developing decision support systems that enable warfighters to take advantage of the FORCEnet and MAGTF C2 and tactically extend Net-Enabled Command and Control (NECC) for shared situational awareness. (3) Providing effective combat identification of enemy combatants, friendly forces, and non-combatants. Activities in this activity provide technologies for secure, robust, self-forming, mobile communications networks distributed computing to support information dissemination to all echelons; and sensors, software and data processing to support formation of appropriate common picture. Marine Corps specific efforts include power management, low detect ability, size and weight constraints, and interoperability within the joint environment. In FY 2008, this effort was funded in the C4ISR activity within this PE. The increase in funding from FY 2008 to FY 2009 is due to this being the first year that C4 has been reported as a separate activity.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY			PROJECT NUMBER 3001	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
The FY 2009 to FY 2010 increase in funding results from the acceleration of efforts to complete and transition Adaptive Networking Technologies efforts. *FY 2009 Plans:* - Initiate development of C3 for the Distributed Operations Marine technologies. This includes development of technologies to allow small units to share Position and Location Information (PLI) in GPS-denied or restricted environments thereby enhancing current blue force situational awareness. - Initiate development of urban/restricted environment communications technologies. - Initiate new efforts in Over-the-Horizon Communications which include the development of an airborne software-defined communications, networking, Electronic Signals Intelligence (ELINT) and Electronic Warfare (EW) capability. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete Free Space Optical Communications Technologies and Adaptive Networking Technologies efforts. (Relates to C4ISR FY 2008 accomplishment of completed development of non-line-of-sight communications technologies). - Initiate Position Location Technologies.					
COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE (C4ISR) 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.		4.232	0.000	0.000	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY			PROJECT NUMBER 3001	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
The FY 2009 funding profile reflects both C4 and ISR efforts now being placed into new and separate activities within this PE. *FY 2008 Accomplishments:* - Continued development of information fusion technologies to allow automated construction of a common tactical picture from various sources of sensor data. (Transitions to ISR activity in FY 2009) - Continued development of low power consumption urban sensing technologies. (Transitions to ISR activity in FY 2009) - Continued development of tagging, tracking and locating technologies to monitor adversary movement. (Transitions to ISR activity in FY 2009) - Continued development of information on demand technologies to provide warfighter with the right information at the right time. (Transitions to ISR activity in FY 2009) - Continued development of urban sensing technologies to detect weapons at distance. (Transitions to ISR activity in FY 2009) - Continued development of adaptable enemy course of action engine to manipulate adversary decisions. (Transitions to ISR activity in FY 2009) - Completed development of conformal, broadband, UHF-VHF antennas. - Completed development of technology to provide position location in GPS restricted environments. - Completed development of non-line-of-sight communications technologies. - Initiated development of advanced tactical sensor technologies to improve unit awareness. (Transitions to ISR activity in FY 2009)					
FIREPOWER 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. The increase in funding from FY 2008 to FY 2009 reflects additional funding for expanded efforts in lightweight weapons and ammunition; exploration of infantry applications associated with emerging USMC requirements in lightening the load of the individual Marine; and a DoD directed integrated capability		2.180	4.273	3.618	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for: - Pre-detonation of IEDs, - Personal protection materials, - Personal power generation, - Micro power sources, and - Augmented reality The integrated demonstration will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. Technologies being developed by the Firepower activity are central to the integrated demonstration program. The FY 2009 to FY 2010 decrease in funding results from delays due to obtaining programmatic milestone approvals in the Targeting and Engagement and Precision Target Location efforts. *FY 2008 Accomplishments:* - Continued development of a concept for an insensitive munition propulsion system to enable firing a shoulder launched rocket from an enclosed space. - Continued development of enhanced mortar munitions for more effective fire support. - Continued investigation of the scalability of variable effects conventional munitions technology for improving firepower effectiveness while increasing affordability and decreasing logistical burden in support of expeditionary warfare. - Continued development of collaborative fires coordination technologies. - Continued development of precision fires engagement technologies. *FY 2009 Plans:* - Continue all efforts of FY 2008.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiate and continue development of Distributed Operations Precision Engagement collaborative fires coordination technologies. - Initiate expanded efforts in lightweight weapons and ammunition (mortars, crew served weapons, ammunition and packaging). - Initiate Targeting & Engagement and Precision Target Location efforts that include Integrated Day/Night Sight Technology. - Initiate design and development of lightweight technologies that provide individual Marines enhanced capabilities to detect and identify man-size targets at least out to the maximum effective range of their personal weapons during all conditions (daylight, limited visibility, & darkness) by integrating multiple capabilities into a single system. *FY 2010 Plans:* - Continue all efforts of FY 2009.				
FORCE PROTECTION This activity supports the Force Protection Thrust's applied research program. Technologies are being developed that focus on the following: Landmine avoidance, detection, and breaching/neutralization; Counter Improvised Explosive Devices; Counter Rocket, Artillery, Mortar, and Sniper; Technologies for improved protection for individuals including Marine Personnel Protective Equipment against blast, ballistic and blunt impact threats and in chemical, radiological, and biological environments; and physical installation and checkpoint security. Beginning in FY 2009, Mine Counter Measure (MCM) efforts are funded within this activity. Force Protection (FP) related technologies, including all MCM and counter Improvised Explosive Device (IED) related technology development are now reflected in this thrust area's submission. FY 2009 reflects additional funding for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for: - Pre-detonation of IEDs, - Personal protection materials,	0.000	3.862	4.210	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Personal power generation, - Micro power sources, and - Augmented reality The integrated demonstration will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. Technologies being developed by the Force Protection activity are central to the integrated demonstration program. The FY 2009 to FY 2010 increase results from accelerating efforts required to complete a neutralization effort focused on applying passive infrared phenomenology understanding to a capability enabling rapid defeat of Passive InfraRed Sensor (PIR) devices from significant stand-off distances. *FY 2009 Plans:* The following efforts transitioned from the Maneuver activity: - Continue development of technologies for stand-off detection and neutralization of mines, IEDs, and UXO. - Continue development of technologies to defeat side/top attack and advanced mine fuzes (seismic, acoustic, and infrared) through advanced signature reduction, duplication, and projection. - Continue spectral signature classification efforts for MCM applications. - Continue development of computational models to scale the effects of small-scale explosives tests to full-scale landmine explosions in order to study mine blast effects on advanced vehicle geometry. - Continue studies into mine signature classification. - Continue technology development programs to address force protection personal protective equipment capability gaps. - Complete development of studies into mine signature classification. - Complete development of modeling tools to accurately determine loading and fragmentation effects on targets from mine explosions.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete evaluation of low passive inter-modulation narrowband antennas and wideband antennas for potential use in detection methodologies. (Relates to Maneuver FY 2008 accomplishment of continued technologies for stand-off detection and neutralization). - Initiate studies of sensor fields to identify and classify mine threats. - Initiate evaluation of active wideband double notch filters for a wide spur-free dynamic range in specific frequencies of interest to cover a variety of threats. - Initiate an Explosive Hazard Defeat for IED Neutralization effort focused on applying passive infrared phenomenology understanding to a capability enabling defeat of PIR devices from significant stand-off distances. - Initiate Counter Rockets, Artillery, Mortars, and Sniper efforts addressing indications and warnings for pre-shot sniper detection and enabling detection of sniper observation and targeting in advance of a ballistic event. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete magnetic and seismic portion of development of technologies to defeat side/top attack and advanced mine fuzes. - Complete high-speed syntactic landmine detection algorithm development to support ground penetrating radars. (Relates to FY 2009 plan to continue development of technologies for stand-off detection and neutralization of mines, IEDs, and UXO). - Complete Neutralization effort focused on applying passive infrared phenomenology understanding to a capability enabling defeat of PIR devices from significant stand-off distances. - Complete vulnerability analysis of selected munitions and targets. (Relates to FY 2009 plan to initiate Counter Rockets, Artillery, Mortars, and Sniper efforts). -Initiate technology development efforts to detect and defeat incoming rocket, artillery, and mortar threats via non-kinetic means. - Initiate multi-spectral protection efforts against battlefield directed energy weapons.				
FUTURE CONCEPTS, TECHNOLOGY ASSESSMENT, AND ROADMAPPING	0.589	0.906	1.057	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
This activity supports the planning and integration of technology development efforts across the entire PE. 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 PE. 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 2009 reflects additional funding for new assessments in Asymmetric/Irregular Warfare and Distributed Operations; and a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for: - Pre-detonation of IEDs, - Personal protection materials, - Personal power generation, - Micro power sources, and - Augmented reality The integrated demonstration will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. *FY 2008 Accomplishments:* - Continued Technology Assessments associated with the Urban Asymmetric and Expeditionary Warfare Capability Gap. - Continued the integrated planning of concepts and technology development.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued development of the Expeditionary Maneuver Warfare Investment Strategy. - Continued Technology Assessments and Roadmapping within Command, Control, Communication, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR); and Firepower Thrust Areas of the PE. - Continued Technology Assessment of the Combating Terrorism portfolio. - Completed implementation of S&T Management Information System. - Initiated assessment of the technical requirements of the Marine Corps Special Operations Command (MARSOC). *FY 2009 Plans:* - Continue all efforts from FY 2008, less those noted as completed above. - Continue assessment of the technical requirements of the MARSOC. - Initiate and continue assessments in Lightening the Marine's Load and Enhancing the Capabilities of the Marine Corps Rifle Squad. - Initiate assessments in Asymmetric / Irregular Warfare and Distributed Operations. - Initiate assessments of all new and emerging Counter Sniper Technologies. - Initiate new planning and integration of technology development efforts to meet imposing security threats that challenge our Nation. *FY 2010 Plans:* - Continue all efforts from FY 2009. - Complete the assessment of the technical requirements of the MARSOC. - Complete assessments of all new and emerging Counter Sniper Technologies. - Complete Technology Assessment of the Combating Terrorism portfolio. - Complete Technology Assessments associated with the Urban Asymmetric and Expeditionary Warfare Capability Gap. - Complete the integrated planning of concepts and technology development. - Complete development of the Expeditionary Maneuver Warfare Investment Strategy.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY			PROJECT NUMBER 3001	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Complete Technology Assessments and Roadmapping within Command, Control, Communication, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR); and Firepower Thrust Areas of the PE. - Initiate an assessment of the S&T impacts of Marine Corps' concept of force employment to meet the need for counterinsurgency and building partnership capacity. How the Marine Corps supports the National Defense Strategy (NDS) and multinational efforts in the Global War on Terrorism/Long War will have long-term S&T impacts.					
HUMAN PERFORMANCE, TRAINING AND EDUCATION 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. The increase from FY 2008 to FY 2009 reflects additional funding for USMC priorities in cognitive and physical enhancement; modeling and simulation; virtual reality squad level training in support of Distributed Operations; and a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for: - Pre-detonation of IEDs, - Personal protection materials, - Personal power generation, - Micro power sources, and - Augmented reality The integrated demonstration will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. Technologies being developed by the Human Performance, Training and Education activity are central to the integrated demonstration program.		2.104	3.495	3.984	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
The FY 2009 to FY 2010 funding increase results from accelerated efforts to complete and transition research into distributed operations peak neural and cognitive performance. *FY 2008 Accomplishments:* - Continued 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. - Continued research in the area of team training task analyses and training effectiveness evaluation techniques to develop more effective training systems for Military Operations in Urban Terrain (MOUT). - Continued and completed 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. - Continued research to evaluate the feasibility of integrating augmented reality technologies into current and emerging training systems. - Continued research on combat feeding and hydration. - Continued research on physiological correlates for the strategic corporal assessment. - Continued development into a Marine performance optimization model. - Continued the development of training effectiveness measures and techniques as applied to disparate, multi-platform, multi-mission team training. - Completed research on combat situation awareness and its effect on combat performance. - Initiated research into distributed operations peak neural and cognitive performance. - Initiated research into next generation survivability enhancement technologies. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Continue studies into next generation physical performance enhancement methodologies and technologies (Continues in PE 0603640M). - Complete evaluation of tools to support real-time cognitive and behavioral assessment (augmented cognition) and improvement of individuals and teams during training.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY			PROJECT NUMBER 3001	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Complete research in the area of team training task analyses and training effectiveness evaluation techniques to develop more effective training systems for MOUT. - Initiate the development of foundational learning theories extended to complex tasks for a range of expertise levels, training mitigation strategies triggered by neurophysiological markers of learning, cognition and expertise, and principles of expertise development on a continuum of novice to expert. - Initiate development of training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition and expertise. - Initiate additional Human Performance and Training efforts (Cognitive and physical enhancement, modeling and simulation, and virtual reality squad level training in support of Distributed Operations). - Initiate Distributed Operations training system investigations to perceptual skills enhancement that lead to enhanced cognition and decision making. - Initiate additional efforts to incorporate effects of nutrition and functional fitness into models and simulations in the Distributed Operations Virtual Toolkit. - Initiate Advanced Mobile Assessment and Field Readiness Technologies to improve the capability to assess situational awareness in the field and predict physical performance by developing mobile, rugged tools, algorithms, and models. - Initiate a Mind-Body Integration Systems effort to improve team training by developing and validating Electroencephalogram (EEG) (and other physiological and performance measures) for use in assessing team performance, coordination, and cohesion in training environments. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete Distributed Operations training system investigations to perceptual skills enhancement that lead to enhanced cognition and decision making. - Complete research into distributed operations peak neural and cognitive performance. - Initiate evaluations of asymmetric distributed learning techniques for distributed operations, language, and cultural training. - Initiate development of team training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiate development of team training/immersive approaches towards language and culture training that incorporate foundational learning theories and other advanced educational methods.				
INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR)	0.000	1.995	2.229	
This activity develops ISR technologies for applications in future intelligence, surveillance, and reconnaissance. Technologies being pursued enhance situational awareness, persistent surveillance, and tactical decision making through automated analysis of data and rapid integration of information and acquired knowledge. Specific technologies in this activity effectively present actionable information to decision-makers, especially those at the lower command levels. This includes complete future automation of options and persistent surveillance in support of distributed operations. In FY 2008, this effort was funded in the C4ISR activity within this PE. The increase in funding from FY 2008 to FY 2009 is due to this being the first year that ISR has been reported as a separate activity. The increases in funding from FY 2009 to FY 2010, are due to enhanced ISR Sensor Field efforts. *FY 2009 Plans:* The following efforts transitioned from the C4ISR activity: - Continue development of information fusion technologies to allow automated construction of a common tactical picture from various sources of sensor data. - Continue development of low power consumption urban sensing technologies. - Continue development of tagging, tracking and locating technologies to monitor adversary movement. - Continue development of information on demand technologies to provide warfighter with the right information at the right time. - Continue development of urban sensing technologies to detect weapons at distance. - Continue development of adaptable enemy course of action engine to manipulate adversary decisions. - Continue development of advanced tactical sensor technologies to improve unit awareness. - Initiate and continue development of distributed information architecture technologies. - Initiate and continue the decision prediction, manipulation, stimulation and learning detection capability to add tools that enable the warfighter to operate inside the OODA loop of an irregular actor. The				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Observe, Orient, Decide, Act (OODA) Loop provides a standard description of decision making cycles that is widely understood and accepted throughout the U.S. military. - Initiate and continue development of a single integrated battlespace picture with tactical and strategic injects that begins to close the gap between ISR and C2. - Initiate and continue Actionable Intelligence for Expeditionary and Irregular Warfare effort which includes real-time methods for Identifying Human Networks. - Initiate tagging, tracking, and locating technologies development to address development of multi-INT track continuity. - Initiate development of advanced tactical nets to include additional phenomenologies and the netting of C2, Sensors and Analysis nodes. - Initiate efforts addressing “battlespace awareness” of human networks, improving the accuracy of classification decisions and enabling a human network predictive capability. Once a human network tensor can be defined and dynamically observed in a common feature space, predictive capabilities are realized. If one network is observed to be moving towards at risk behavior, a generalized force warning may be enabled addressing the threat associated with all networks with similar human network tensors. When combined, research into human network awareness, network classification and network prediction, will be a powerful tool for warfare against the irregular actor. *FY 2010 Plans:* - Continue all efforts from FY 2009. - Complete development of urban sensing technologies to detect weapons at distance. - Initiate new Sensor Fields efforts such as Nanotechnology Enabled Witness Fields, development of sensors that provide near real time decision support to distributed operations by detecting specific interactions, and nanotechnology efforts which offer the potential to revolutionize tactical sensors. To enable this capability, nanomaterials that change state in the presence of another nanomaterial will be developed. - Initiate efforts to track entities of interest in a high clutter environment via geolocation of optical tags from a UAV platform. - Initiate development of capabilities to integrate socio-cultural models of human behavior with the ability to forecast the processes of decision making through predictive forecasting models.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY			PROJECT NUMBER 3001	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate development of approach to model and expose enemy networks, actions, and reactions through statistical models with techniques for probabilistic forecasting of behaviors of interest with consideration for open source information and conventional intelligence data sources. - Initiate development of sensors that provide near-real-time decision support to distributed operations by detecting specific interactions utilizing nanotechnology. - Initiate efforts to derive high resolution models of human networks statistically with associated behavior attributes.					
LITTORAL COMBAT/POWER PROJECTION This activity is aligned with the Sea Strike, Sea Shield, Sea Basing and FORCEnet pillars and provides the capability for the demonstration and transition of technologies developed through the related Marine Corps S&T programs directly to an acquisition program of record. The funding profile reflects the alignment of the FNC program investments into ECs. Funding for each EC is aligned to a 6.2 or 6.3 Budget Activity (BA) as appropriate. The focus of the ECs within this PE will be on technology related to Urban, Asymmetric, Littoral and Expeditionary Operations. The related science and technology development is of the highest importance to Marine Corps operations in Iraq, Afghanistan and the GWOT. The technologies associated with these gaps are being pursued as part of an overall effort that addresses Sea Strike, Sea Shield, Sea Basing and FORCEnet Capability Gaps. Warfighter Capability Gaps are made up of ECs and supporting products. This activity includes support to the Urban, Asymmetric Operations-related EC's for IED's, Modular Scalable Effects Weapons, Advanced Naval Fires Technology, Dynamic Target Engagement, Position Location Information, Transparent Urban Structures, Hostile Fire Detection and Response, Lightweight Protective Systems, and Lightening the Load of Dismounted Combatants. *FY 2008 Accomplishments:* - Continued Expeditionary Fighting Vehicle (EFV) obstacle avoidance subsystem design, integrated subsystems and prepared for demonstration.		8.734	9.657	9.750	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued efforts to provide urban direction finding of Radio Frequency (RF) emitters from moving platforms. (Concurrent funding in PE 0603640M.) - Continued effort in Distributed Common Ground/Surface System (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. - Continued development of target acquisition architecture, information exchange, connectivity and interoperability of target hand-off, fire control, and coordination systems. (Concurrent funding in PE 0603640M.) - Continued design and test of hostile fire detection and counter-fire system (GUNSLINGER). - Continued development of integrated vehicle self-defense system technologies to defeat incoming Rocket Propelled Grenades (RPGs). (Concurrent funding in PE 0602782N.) - Continued development and integration of network monitoring and management tools technology and transition to acquisition. (Concurrent funding in PE 0603782N.) - Continued integration and demonstration of innovative relays Beyond Line Of Sight (BLOS) in the areas of wideband communications and advanced modular systems. (Concurrent funding in PE 0603782N.) - Continued development of algorithms and initiated modifications of hardware and software for use in discriminating between individual single channel RF emitters on the battlefield and determining their locations; provide algorithms to MARCORSYSCOM Program Manager (PM) INTEL. (Concurrent funding in PE 0603782N.) - Continued development and began transitioning EFV obstacle detection capability to EFV Direct Reporting Program Manager. - Continued development of land mine countermeasure insensitive munitions technology. - Continued development of integrated vehicle self-defense system to defeat incoming RPGs. - Continued development of tactical ISR data structures and pattern recognition algorithms. - Continued advanced concept development to alert approaching targets with an unambiguous warning that, if ignored, will clearly demonstrate hostile intent of the approaching target. (Realigned from PE 0602123N.) - Continued transparent urban structure ‘see thru the wall’, image and mapping technologies development. - Continued modular scalable effects weapons technologies development.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued development of an integrated company level Urban Sensor Suite. (Automated Control of Large Sensor Networks) (Transitions to PE 0602235N.) - Continued detect and identify facilities technology development. (Transparent Urban Structures) - Continued decision aids technology development. (Transparent Urban Structures) - Continued indirect prototype technology development. (Modular Scalable Effects Weapon) - Initiated development of Modular Scalable Effects weapons technologies. (Concurrent funding in PE 0603640M.) - Initiated development of counter Improvised Explosive Device (IED) technologies. (Concurrent funding in PE 0603640M.) - Initiated development of tactical urban breaching technologies. (Concurrent funding in PE 0603640M.) *FY 2009 Plans:* - Continue all efforts of FY 2008. - Initiate development of individual Warfighter protection technologies. (Concurrent funding in PE 0603640M). - Initiate development of advanced survivability and mobility technologies for Marine Corps tactical and combat vehicles. (Concurrent funding in PE 0603640M and 0603236N). *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete development and transition improved fire control technologies based on small-scale hardened non-magnetic azimuth sensor to improve timeliness and accuracy of mortars/howitzers. (Concurrent funding provided by PE 0602114N.)				
LOGISTICS 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,	2.535	3.410	4.809	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
sustainment, reconstitution/redeployment, and command and control. These pillars are thoroughly integrated and perpetually related in execution. The increase from FY 2008 to FY 2009 reflects additional funding for additional efforts in lightweight portable battlefield power sources supporting USMC priorities in lightening the load of the individual Marine and enhancing the Marine Corps rifle squad's overall capabilities; and a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for: - Pre-detonation of IEDs, - Personal protection materials, - Personal power generation, - Micro power sources, and - Augmented reality The integrated demonstration will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. Technologies being developed by the Logistics activity are central to the integrated demonstration program. The FY 2009 to FY 2010 increase results from initiation of new applied research directed at producing a lightweight device for converting hydrocarbon fuels to electrical energy. *FY 2008 Accomplishments:* - Continued developing and assessing concepts that permit precision delivery of logistics assets while also reducing the logistics footprint ashore. - Continued development of an alternate power source to reduce logistics footprint and increase sustainability of Marine expeditionary forces. - Continued assessment of 20W Stirling Engine for increased efficiency during distributed operations. - Continued assessment of portable, alternative water purification systems.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY			PROJECT NUMBER 3001	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued analysis of Personal Power Network / Centralized Distributed Operations Power Generation System. - Initiated development of wireless vehicle health diagnosis and reporting. - Initiated development of advanced logistics distribution system. *FY 2009 Plans:* - Continue all efforts from FY 2008. - Complete analysis of Personal Power Network for transition to “Lighten the Load” FNC EC beginning in FY 2010. - Initiate advancement of a solid oxide fuel cell capable of directly oxidizing liquid logistic fuels such as JP-8, thus eliminating the necessity for both reforming and sulfur removal pre-processing of the fuel. - Initiate advancement of high specific energy electrochemical capacitors to function as peak electric load-leveling buffers in advanced lightweight portable power applications. - Initiate applications of advanced material surface treatments and coatings for reducing required maintenance and enhancing operational readiness of expeditionary warfare vehicles, machinery, and electrical systems. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Initiate applied research toward producing a light weight device for converting hydrocarbon fuels to electrical energy.					
MANEUVER The Maneuver thrust area focuses on the development, demonstration, and transition of technologies that will increase the warfighting capabilities and effectiveness of the Marine 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, modularity, and unmanned systems. Special emphasis on survivability technologies for the defeat of small arms, IEDs, mine blast, and RPGs continue to be incorporated into this thrust area. Efforts also continue in the development of modeling and simulation tools that integrate many different physics based modeling systems with rigorous operational		5.581	5.784	6.309	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Finally, this technology thrust area also seeks to develop technologies to enhance combat vehicle crewman effectiveness and situational awareness through the incorporation of advanced autonomous vehicle functions triggered directly by the cognitive state of the operator. Beginning in FY 2009, Mine Counter Measure (MCM) efforts are funded under the Force Protection activity. Force Protection (FP) related technologies, including all MCM and counter Improvised Explosive Device (IED) related technology development are now reflected in that thrust area's submission. The increase in funding from FY 2009 to FY 2010 is due to initiation of technology programs to improve/ increase occupant protection within the platform by reducing injury due to the effects of dynamic blast events and accidental vehicle rollover. *FY 2008 Accomplishments:* - Continued lightweight Expeditionary Systems Materials (ESM) efforts to determine feasibility of scaling and producing candidate structural armor. - Continued Cognitive Assessment and Task Management technologies for combat vehicle crewmen (formerly Augmented Cognition effort). - Continued development of Advanced Electromagnetic Armor (E-NERA). - Continued S&T programs to address MAGTF Land MCM Master Plan capability gaps. - Continued technologies for stand-off detection and neutralization of mines, IEDs, and Unexploded Ordnance (UXO). (Transitions to Force Protection activity in FY 2009) - Continued technologies to defeat side/top attack and advanced fuse mines through signature reduction and advanced signature duplication. (Transitions to Force Protection activity in FY 2009) - Continued development of modeling tools to accurately determine loading and fragmentation effects on targets from mine explosions. (Transitions to Force Protection activity in FY 2009) - Continued development of technologies to defeat advanced mine fuzes (seismic, acoustic, and infrared). (Transitions to Force Protection activity in FY 2009)				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued development of computational models to scale the effects of small-scale explosives tests to full-scale landmine explosions in order to study mine blast effects on advanced vehicle geometry. (Transitions to Force Protection activity in FY 2009) - Continued development of countermeasures for smart mine sensors. - Continued mobility enhancement development effort for current and future light and medium weight Marine Corps vehicle programs. - Continued and completed development of materials to promote Combat Science and Technology Vehicle (CSTV) survivability. - Continued development of advanced electromagnetic armor for ground vehicle survivability. - Continued development of cognitive assessment and task management concept for CSTV. - Completed development of scalable explosive neutralization methods. - Initiated integration of CSTV capabilities. - Initiated development of fuel efficiency and battlefield power technologies for the CSTV and ground vehicles. - Initiated studies into mine signature classification. (Transitions to Force Protection activity in FY 2009) - Initiated technology development programs to address force protection capability gaps. (Transitions to Force Protection activity in FY 2009) - Initiated spectral signature classification efforts for MCM applications. (Transitions to Force Protection activity in FY 2009). *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Initiate efforts addressing survivability and technologies to mitigate acceleration and traumatic brain injuries to vehicle occupants to enhance tactical mobility in support of Distributed Operations. - Initiate efforts addressing advanced suspension systems with ride height adjustment capabilities, adjustable ride quality capabilities, rollover prevention, and load equalizing systems to enhance tactical mobility and survivability in support of Distributed Operations. - Initiate efforts addressing improvements in vehicle fuel efficiency by improvements in drive train efficiencies, engine efficiencies and alternative fuels capabilities to enhance tactical mobility in support of Distributed Operations.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiate technology development programs to address maneuver capability gaps in Survivability such as an Advanced Seat Technology effort to improve/increase occupant protection within the platform by reducing injury due to the effects of dynamic blast events and accidental vehicle rollover. - Initiate technology development programs to address maneuver capability gaps in Mobility such as a Vehicle Stability effort to improve/increase vehicle performance characteristics such as reducing vehicle rollover tendencies. *FY 2010 Plans:* - Continue all efforts of FY 2009.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0204163N/Fleet Telecommunications (Tactical)									Continuing	Continuing
PE 0206313M/Marine Corps Communications Systems									Continuing	Continuing
PE 0206623M/Marine Corps Ground Combat/ Supporting Arms Systems									Continuing	Continuing
PE 0601152N/In-House Laboratory Independent Research									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602235N/Common Picture Applied Research									Continuing	Continuing
PE 0602782N/Mine and Expeditionary Warfare Applied Research									Continuing	Continuing
PE 0603004A/Weapons and Munitions Advanced Technology									Continuing	Continuing
PE 0603005A/Combat Vehicle and Automotive Advanced Technology									Continuing	Continuing
PE 0603235N/Common Picture Advanced Technology									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602131M MARINE CORPS LANDING FORCE TECHNOLOGY	PROJECT NUMBER 3001

PE 0603236N/Warfighter Sustainment Advanced Technology	Continuing	Continuing
PE 0603606A/Landmine Warfare and Barrier Advanced Technology	Continuing	Continuing
PE 0603612M/USMC Mine Countermeasures Systems - Adv Dev	Continuing	Continuing
PE 0603635M/Marine Corps Ground Combat/ Support System	Continuing	Continuing
PE 0603640M/USMC Advanced Technology Demonstration (ATD)	Continuing	Continuing
PE 0603782N/Mine and Expeditionary Warfare Advanced Technology	Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

The primary objective of this PE is the development of technologies to meet unique Marine Corps needs in conducting Expeditionary Maneuver Warfare and Combating Terrorism. The program consists of a collection of projects categorized by critical warfighting function. Individual project metrics reflect the technical goals of each specific project. Typical metrics include the advancement of related Technology Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602234N MATERIALS, ELECTRONICS AND COMPUTER TECHNOLOGY					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	1.931	7.280	0.000						Continuing	Continuing
0000: MATERIALS, ELECTRONICS AND COMPUTER TECHNOLOGY	1.931	7.280	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

This Program Element is funded in its entirety by two Congressional Adds.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	1.987			
Current BES/President's Budget	1.931	7.280		
Total Adjustments	-0.056	7.280		
Congressional Program Reductions		-0.020		
Congressional Rescissions				
Total Congressional Increases		7.300		
Total Reprogrammings				
SBIR/STTR Transfer	-0.056			

Congressional Increase Details ($ in Millions)

	FY 2008	FY 2009
Project: 9999, **INFRARED MATERIALS LABORATORIES**	1.931	2.493
Project: 9999, **NOVEL COATING TECHNOLOGIES FOR MILITARY EQUIPMENT**	0.000	4.787

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602234N MATERIALS, ELECTRONICS AND COMPUTER TECHNOLOGY					PROJECT NUMBER 0000	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
0000: MATERIALS, ELECTRONICS AND COMPUTER TECHNOLOGY	1.931	7.280	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

This Program Element is funded in its entirety by two Congressional Adds.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Congressional Plus-Up	0.000	0.000	0.000	

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Not applicable/Not applicable									Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Not applicable.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	105.732	85.209	83.163						Continuing	Continuing
0000: COMMON PICTURE APPLIED RESEARCH	105.732	85.209	83.163						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval Science and Technology (S&T) Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

Activities and efforts in this program examine concepts and technologies that enable the transformation to network centric warfare. Network centric capabilities rely on information to connect assets and provide timely and accurate understanding of the environment. The mission area requirements for rapid, accurate decision-making; dynamic, efficient, mission-focused communications and networks; and pervasive and persistent sensing drive network centric S&T investments. The program focus is on S&T enabling technologies that provide decision making and mission execution to achieve battlespace superiority. Program activities seek to develop hardware and software technologies that (1) identify and integrate informational content from multimedia sources including images, and intelligence sources; (2) integrate massive amounts of information; and (3) provide automatic correlation, fusion, and insight to support user-cognitive processes. Particular programmatic emphasis will be placed on automating the association of objects and events in the battlespace and automatically transforming this information into actionable knowledge (e.g., indications and warnings of intent). In current and future operational environments such as Overseas Contingency Operations (OCO) and Maritime Domain Awareness (MDA), warfighters require technologies evolved to support information needs regardless of location and that are consistent with the user's level of command or responsibility within varying operational situations. Net-centric operations include communications and information assurance capabilities to enable all-source data access, multi-source processing, and tailored dissemination of information to Command and Control (C2) and Intelligence, Surveillance and Reconnaissance (ISR) users across the network. The operational benefits sought are increased speed of response, accuracy and precision of command; distributed self-synchronization; flexibility and adaptability to an operational situation; and decision superiority. 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.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	**R-1 ITEM NOMENCLATURE** PE 0602235N COMMON PICTURE APPLIED RESEARCH

This program explores and demonstrates technologies that enable options for the Navy's FORCEnet, Sea Shield, and Sea Strike pillars and contains investments in the following Enabling Capabilities (ECs): Combat Identification (ID) Information Management of Coordinated Electronic Surveillance, Automated Control of Large Sensor Networks, GWOT Focused Tactical Persistent Surveillance, Globally Netted Joint/Coalition Force Maritime Component Commander, Dynamic Tactical Communications Networks, Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC), High-bandwidth Free-space Lasercomm, Actionable Intelligence Enabled by Persistent Surveillance, and Real-Time Long Range Air Defense Combat ID in Support of Early Engagement. 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; and 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.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	103.751	77.054	83.719	
Current BES/President's Budget	105.732	85.209	83.163	
Total Adjustments	1.981	8.155	-0.556	
Congressional Program Reductions		-0.319		
Congressional Rescissions				
Total Congressional Increases		8.500		
Total Reprogrammings	2.790			
SBIR/STTR Transfer	-0.809			
Program Adjustments			0.070	
Rate/Misc Adjustments		-0.026	-0.626	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **ADVANCED PANORAMIC SENSOR SYSTEMS FOR UAVS**	0.772	0.000
Project: 9999, **ALL WEATHER SENSE & AVOID SENSORS FOR UAVS**	2.317	2.492
Project: 9999, **LAYERED SURVEILLANCE/SENSING**	0.000	1.596
Project: 9999, **M2C2**	3.085	0.000
Project: 9999, **RADIO SENSOR MODULE (RASM)**	1.543	0.000
Project: 9999, **SENSOR INTEGRATION FRAMEWORK**	0.000	1.197
Project: 9999, **SOF TEST ENVIRONMENT FOR ADV TEAM COLLABORATION MISSIONS**	0.000	1.995

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **THEATER UNDERSEA WARFARE INITIATIVE (TUSW)**	3.099	0.000
Project: 9999, **UNMANNED GROUND VEHICLE (UGV) MOBILITY & COORDINATION IN JOINT URBAN/LITTORAL ENVIRONMENTS**	0.772	1.197

Change Summary Explanation

Technical: Not applicable

Schedule: Not applicable

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH					PROJECT NUMBER 0000	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
0000: COMMON PICTURE APPLIED RESEARCH	105.732	85.209	83.163						Continuing	Continuing

A. Mission Description and Budget Item Justification

Activities and efforts in this program examine concepts and technologies that enable the transformation to network centric warfare. Network centric capabilities rely on information to connect assets and provide timely and accurate understanding of the environment. The mission area requirements for rapid, accurate decision-making; dynamic, efficient, mission-focused communications and networks; and pervasive and persistent sensing drive network centric S&T investments. The program focus is on S&T enabling technologies that provide decision making and mission execution to achieve battlespace superiority. Program activities seek to develop hardware and software technologies that (1) identify and integrate informational content from multi-media sources including images, and intelligence sources; (2) integrate massive amounts of information; and (3) provide automatic correlation, fusion, and insight to support user-cognitive processes. Particular programmatic emphasis will be placed on automating the association of objects and events in the battlespace and automatically transforming this information into actionable knowledge (e.g., indications and warnings of intent). In current and future operational environments such as Overseas Contingency Operations (OCO) (formerly Global War on Terrorism (GWOT)) and Maritime Domain Awareness (MDA), warfighters require technologies evolved to support information needs regardless of location and that are consistent with the user's level of command or responsibility within varying operational situations. Net-centric operations include communications and information assurance capabilities to enable all-source data access, multi-source processing, and tailored dissemination of information to Command and Control (C2) and Intelligence, Surveillance and Reconnaissance (ISR) users across the network. The operational benefits sought are increased speed of response, accuracy and precision of command; distributed self-synchronization; flexibility and adaptability to an operational situation; and decision superiority. 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.

This program explores and demonstrates technologies that enable options for the Navy's FORCEnet, Sea Shield, and Sea Strike pillars and contains investments in the following Enabling Capabilities (ECs): Combat Identification (ID) Information Management of Coordinated Electronic Surveillance, Automated Control of Large Sensor Networks, GWOT Focused Tactical Persistent Surveillance, Globally Netted Joint/Coalition Force Maritime Component Commander, Dynamic Tactical Communications Networks, Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC), High-bandwidth Free-space Lasercomm, Actionable Intelligence Enabled by Persistent Surveillance, and Real-Time Long Range Air Defense Combat ID in Support of Early Engagement. 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; and 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.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
COMMUNICATION AND NETWORKS	8.989	9.417	8.226	

The overarching objective of this activity is to develop high throughput dynamic wireless communications and networks technologies critical to the mission performance and robustness of naval communications for widely dispersed mobile air, land, surface and submerged platforms. These platforms are often size, weight and power (SWaP) limited, and will operate under constraints of cluttered RF spectrum, harsh electro-magnetic interference (EMI) and Beyond Line Of Sight (BLOS) conditions. The technical payoff is increased network data rates, interoperability across heterogeneous radios, dynamic bandwidth management, and greater mobile network connectivity. The operational payoff is that warfighters from the operational command to the tactical edge have near real-time access to information, knowledge and decision-making necessary to perform their tasks, including coalition and allied forces. Emphasis is on tactical edge communications and networks to fully realize net-centric warfare, bridging the GIG and the 'disadvantaged user', e.g., small-deck combatants, submarines, unmanned vehicles, distributed sensors and ground units in urban and radio frequency (RF) challenged environments. The current specific objectives are:

a) Radios and Apertures: Develop technologies for high band radio, electrically-small and actively-scanned antennas, addressing critical issue of radio spectrum bandwidth efficiency, spectrum contention and clutter, agile frequency communications with dynamic spectrum access, all-digital front-end with wide dynamic range, power amplifier efficiency, multipath effects, saltwater propagation and BLOS communications. Develop algorithms and signal processing for space-time-frequency diversity communications, including measures for electronic protection, such as low-intercept anti-jam waveforms and modulation. Develop affordable antenna technologies for small size and weight, high radiation efficiency, and wideband operation with rapid beam-steering. Develop alternatives to RF communications in airborne and terrestrial environments as well as high data rate underwater communications for undersea warfare (distributed sensors netting, unmanned underwater vehicle data exfiltration, submarine Communications at Speed and Depth) using electro-optic/infra-red (EO/IR) technologies. Develop secure, high bandwidth communications systems and the exploitation of existing and emerging network protocols that will avail development of new Low Earth Orbit (LEO) based data transport mechanisms.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
b) Tactical Networking and Network Control/Management: Develop advanced networking techniques for robust, highly dynamic environments; interoperable networks for secure communications and protocols, bandwidth and network management techniques that manage and allocate bandwidth across tactical and theater levels in support of net-centric operations. Develop rapidly auto-configuring and self-organizing networks with efficient and survivable routing, secure authentication, mobility management and Quality-of-Service guarantee while optimizing network resources. Address low bandwidth, synchronization and reliability for Service Oriented Architecture (SOA)/middleware architecture in both mobile ad-hoc networks (MANET) and infrastructure-based Internet Protocol (IP) backbone networks. Develop cognitive network planning and operations engines whose criteria are based directly on mission objectives while self-adapting and managing the spectrum allocation and radio resources in such a way that network operations, SOA community of interest, and computer network defense are integrated to form a single common tactical network picture that requires a minimum of human intervention and skill. Develop technology for improving tactical edge networking and for improving voice communications. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. *FY 2008 Accomplishments:* Radios and Apertures: - Continued efforts to mature the superconducting cross-correlator to technology readiness level 4 to enable the development of a multi-function multi-net digital-Radio Frequency dehopping receiver for Link-16. This involves the integration of High Temperature Superconductors analog and Low Temperature Superconductors digital circuits in a COTS two-stage cryocooler. - Continued project to architect multi-Mega bits per second (Mbps) naval laser communication system for ships. Designed rate-adaptable optical receiver using avalanche photo-diodes and array-detection techniques for improved performance in poor weather conditions. - Continued Broadband Electronically-steerable Array for Mission Security (BEAMS), a low cost analog beam forming and steering technique for UAV to UAV and UAV to ground station communications. - Continued development of an adaptive rate terminal to maintain laser communications in poor weather conditions.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued the development of free space hybrid Infrared laser communications links with greater than 10X bandwidth of digital link for same power. - Continued development of digital beam forming and steering for small UAVs in upper Ka band (38 GHz), including Risley prism conformal antennas and lightweight switched beam antennas made of composite materials. - Continued development of small foot-print, low-power fly-by optical communications underwater between unmanned underwater vehicles (UUV)/unmanned surface vehicles (USV) and bottomed sensor field, utilizing blue-green directly modulated semiconductor lasers. - Continued development of submarine to UUV/USV/sensor comms using underwater Modulating Retroreflector technology. - Continued techniques for ultra-wide band (UWB) range extension by time reversal and other methods, including receiver prototyping. - Continued development of low-cost integrated stub antenna and ferroelectric phased array technology for directional communications. - Continued the development of pattern recognition algorithms to allow detection and identification of intruders into remote or urban areas. - Continued the development of technical characteristics of a Communications Electronic Attack (EA) system that consists of a master EA platform that operates in concert with a network of simple subordinate platforms. - Completed prototyping of the high data rate (HDR) communications (> 1 Gbps data links) for small tactical UAVs in ISR applications, meeting the size, weight and power requirements. - Completed development of an UWB groundwave communication transceiver and high frequency (HF) antenna for a distributed sensor network and gateway buoys. - Completed development of a concept for recovering GPS signals in a "friendly" jamming environment thus allowing GPS to be used while denying that capability to an adversary. - Initiated development of underwater Extremely Low Frequency (ELF) antenna and RF technology for submarine comms at speed and depth. - Initiated development of metamaterial structures and periodic inductive and capacitive loading for submarine High-Frequency Internet Protocol (HF-IP) buoy-cable antennas (BCA).				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Tactical Networking and Network Control/Management: - Continued development of Robust Airborne Networking Extensions (RANGE) for joint battlespace networking, networking UAVs, and hybrid mobile ad hoc networking (MANET)/satellite operation. Implemented MANET protocols for cross-layer optimized routing, including disruption tolerant networking to sensors and platforms. - Continued development of advanced topology and medium access control (MAC) for extremely low power consuming sensor networks. - Completed development of RANGE protocols and software kit for dynamic inter-UAV networking. - Completed development of protocols and algorithms for mobility and security in emerging IPv6 next generation MANETs. - Initiated development of service oriented networking protocols and middleware for the tactical warfighter and platforms. - Initiated the development of wireless-ready, reliable data transport technologies suitable for tactical-edge and afloat networks. *FY 2009 Plans:* Radios and Apertures: - Continue all efforts of FY 2008 less those noted as completed above. - Complete prototyping of the conformal array for digital beam forming and steering on small UAVs in upper Ka band (38 GHz). - Complete development of small foot-print, low-power fly-by optical communications underwater between UUVs/USVs and bottomed sensor field, utilizing direct modulated semiconductor lasers or modulating retro-reflectors (MRR)in the blue-green band. - Complete prototyping of receivers that demonstrate UWB range extension by time reversal methods. - Complete the development of free space hybrid Infrared laser communications links with greater than 10X bandwidth of digital link for same power. - Complete the development of pattern recognition algorithms to allow detection and identification of intruders into remote or urban areas. - Initiate development of Line of Sight (LOS) high data rate UAV-sensor communications for expeditionary forces.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiate development of advanced signal processing, coding and switching amplifier techniques for high power amplification. - Initiate metamaterials based dish antennas development for Ka-Ku band satellite communications (SATCOM). - Initiate development of low intercept and low probability of Detection (LPD), jam resistant communications/networks for distributed nodes. - Initiate blue-green fiber laser technology development for space-based submarine communications. Tactical Networking and Network Control/Management: - Continue all efforts of FY 2008 less those noted as completed above. - Complete development of advanced topology and MAC for extremely low power consuming sensor networks. - Initiate development of network coding and cognitive radio networking technologies with heterogeneous links. *FY 2010 Plans:* Radios and Apertures: - Continue all efforts of FY 2009 less those noted as completed above. - Complete ultra wideband time reversal technique improvement, up to a factor of 2 compared to when channel estimation techniques are not used. - Initiate development and demonstrate electrically small antennas at VLF/HF, as well as lightweight beam steering antennas for UAVs using switched (ferrite) multi-horns and Risley prisms with 15-30 dB gain and 1.5 GHz bandwidth in the 38 GHz band. - Initiate design and development of low observable jam resistant waveform, including directionalization, for advanced tactical data links. - Initiate design and development of electronic protection for HF communications. Tactical Networking and Network Control/Management: - Continue all efforts of FY 2009 less those noted as completed above.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate development of a SOA-based secure tactical wide area network for coalition forces, showing independence of coalition tactical communications from satellite backhaul, bandwidth management and service discovery. - Initiate development of topology control, discovery mechanisms and directional networking for free-space optical links. - Initiate demonstrations of pattern recognition algorithms to allow detection and identification of intruders into remote or urban areas; develop technical characteristics of a Communications Electronic Attack (EA) system that consists of a master EA platform that operates in concert with a network of simple subordinate platforms; develop wireless-ready, reliable data transport technologies suitable for tactical-edge and afloat networks. - Initiate design and development of cognitive netops for tactical communications.					
COMPUTATIONAL FRAMEWORK AND METHODS FOR RAPID ACCURATE DECISION MAKING (FORMERLY NETWORK COMMAND, CONTROL AND COMBAT SYSTEMS) The goal of this activity is to support FORCEnet by developing enablers for decision making and mission execution to achieve battlespace superiority. It focuses on the development of algorithms and software technologies that identify and integrate informational content from multiple sources, leading to decision aids that support user-cognitive processes. Because persistent sensors are generating massive amounts of data, the focus is on technologies that not only integrate information from diverse sources, but also provide indications of information significance in ways that support the user's decision needs regardless of location and operational situation. To achieve this, it must be possible to automate understanding of the battlespace by identifying objects, determining relationships among the objects, assessing intent, and automatically generating courses of action with associated risks and uncertainty. Effort will also be devoted to developing technology for increasing assurance and security for C3 information systems and technology for improving information discovery and information presentation in such systems. The current specific objectives are: a) Automated Intelligence Tools: Develop automated image and signal intelligence understanding tools based on rigorous mathematical and statistical methods that lead to improved change detection, improve		24.084	23.950	25.532	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
object and activity detection and recognition capabilities, context and scene understanding, and inferring of the threat levels to support decision making and persistent and adaptive surveillance. b) Battlespace Sensor and Intelligence Integration: Develop innovative methods for combining traditional and non-traditional data from sensors and disparate sources to provide the best estimate of objects, events, and conditions in the battlespace, in terms of their identity, associated error or uncertainty, context, impact, and infer relationships and their intentions. c) Automated Reasoning Methods and Models for Situational Analysis: Develop rigorous and efficient methods for building sophisticated situational models, develop automated reasoning techniques to categorize and recognize situations under a variety of conditions leading to methods that predict situations under different settings. d) Automated Decision Tools: Develop automated decision tools based on mathematically rigorous techniques (e.g., mathematical optimization) that support decision-making to ensure the best use of scarce and/or expensive resources to achieve optimal allocations for large complex scenarios, including ones that contain uncertainty, in drastically reduced amounts of time. Develop methods that support decision making in networked sensor management and allocation to ensure sensor assets are deployed in an optimal or near optimal manner. e) Secure Sensor Networks: Develop tools and methods to securely handle information without exposing intelligence information about the networks or systems to adversaries. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. *FY 2008 Accomplishments:* - Automated Intelligence Tools: - Continued the demonstration and conducted image registration error analysis for the multi-resolution and multi-scale image processing effort.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued development of automated methods for identifying significant changes between temporally separated images (not video) to extend work on automatic target recognition and pattern recognition into change detection algorithms. - Continued efforts in automated image understanding that use active computations and visual pattern recognition for networked target recognition systems in maritime domain awareness. - Continued development of semi-supervised detection algorithms for multi-sensor imagery, video and human intelligence that will enable self-deploying sensor networks. - Continued development of a scalable system design for coordinated Unmanned Aerial Vehicle (UAV) formation control that integrates onboard and off-board sensor data. - Continued development of interactive image/video-based surveillance systems for perimeter protection, and port protection. - Completed the development of a feature extraction module that segments the video based on video mosaicing. - Completed the development of algorithms with Naval/Joint imagery systems to handle video metadata, which includes Global Positioning System, time, and sensor information. - Completed the development of recommendations for standardizing the storage and linking of feature descriptions within a common database framework. - Completed development of technology to improve collaborative operational planning for tactical users using Head-Up Displays. - Initiated the development of a new radar signature analysis technique based on nonlinear dynamics. - Initiated the development of a novel particle filter-based elevation angle tracking algorithm to improve the capability to track low-angle targets over the sea surface under multipath conditions using passive sensors. - Initiated the development of the theory and technology for near-field electromagnetic (EM) phenomenology relevant to high resolution, through-the-wall imaging at close ranges in urban operations. Battlespace Sensor and Intelligence Integration: - Continued the development of a Case-Based Reasoning simulation/model for implementing situation, threat awareness fusion solutions and a Bayesian Network inference engine for manipulating uncertainty and learning from data.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued development of technology for improving voice data interpretation and presentation to cope with audio information overload in Navy Systems. - Continued demonstration of a trusted data store which maintains data pedigree and detects anomalies in a limited objective experiment. - Continued efforts in Joint Director of Laboratory's Data Fusion Model Level 1/2/3 data fusion using abductive reasoning, Bayesian networks, agent-based techniques, statistical-based methods, and other approaches. - Continued efforts in the automated integration of disparate sources of information that involve data mining methods and game theory. - Continued development of an interface between the Level 1 and Level 2/3 data fusion processes across federated service oriented architectures. - Continued development of new data schemas and methods to allow more efficient assembly of a common operational picture (COP) integrating informational content from images, track data, intelligence and incomplete track data. - Continued Level 1 fusion algorithm and architecture design with associated ontology to manage information from automated sensors to provide a more dynamic and accurate battlespace picture through improved object refinement. - Completed the development of algorithms and demonstration of data reduction through joint classification and feature optimization, realizing transfer of data to information, realizing A/I vis-a-vis Analog/Digital data (reduced bandwidth requirements and reduced burden on analysts and warfighters). - Completed the development and characterization of new target detection and recognition algorithms to exploit higher dimensional data (spatial, temporal, and spectral) within the Network Centric Warfare framework. Approach uses advanced correlation approaches to provide improved target detection and recognition performance by integrating multiple sensor measurements. - Completed the development of a suitable ontology for exercising large-scale distributed situational threat awareness in Naval battlespace environments. - Completed the augmentation of the real world information with computer-generated information in the Battlefield Augmented Reality System effort. The activity designed a modular framework to support the system design and enables the insertion of custom scheduling and replication solutions. Other efforts focused on the middleware layer to support emerging network centric sensor-to shooter systems.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated the development of software and algorithms for integrating the functions of target acquisition, tracking, data computation, and engagement control across multiple platforms for engaging multiple threats. - Initiated the investigation of service oriented methods to automatically retrieve relevant information for a community of interest. - Initiated the development and testing of the Joint Integrated Fires Control effort. Automated Reasoning Methods and Models for Situational Analysis: - Continued demonstration of predictive surface platform threat behavior algorithms and software employing techniques using pattern recognition on geospatial and attribute data. Also developed autonomous monitoring and reporting of high interest and anomalous maritime vessels. - Continued development of methods for automated generation of courses of action, including techniques for automated planning and reasoning in uncertain environments. - Continued efforts in ontology-based information fusion for enhanced situational awareness and classification-based knowledge discovery. - Continued demonstration of 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. Automated Decision Tools: - Continued development of sensor management algorithms that reduce the amount of labeled training data required, employing semi-supervised classifier and active learning techniques motivated by asymmetric threat, which limited training data anticipated. - Completed demonstration of a FORCEnet limited objective experiment involving the application of new techniques of discrete optimization, statistical discrimination, and artificial intelligence for the resource allocation of weapons. Compared initial results with high fidelity physics based models for threat and anti-threat weapon systems for continued development of Anti-Air Warfare optimization algorithms. - Initiated the development of methods for selecting sensors and platforms for search and surveillance operations in a theater, allocating the selected sensors and platforms to specific missions, operating the allocated sensors during a mission, and fusing the information from the sensors and other sources.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Secure Sensor Networks: - Continued the development of 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. - Continued development of technology to improve reliability of systems to survive Information Warfare attacks. - Continued development of technology for improved steganography and watermarking. *FY 2009 Plans:* - Automated Intelligence Tools: - Continue all efforts from FY 2008 less those noted as completed above. - Complete development of automated methods for identifying significant changes between temporally separated images (not video) to extend work on automatic target recognition and pattern recognition into change detection algorithms. - Complete efforts in automated image understanding that use active computations and visual pattern recognition for networked target recognition systems in maritime domain awareness. - Complete development of a scalable system design for coordinated Unmanned Aerial Vehicle (UAV) formation control that integrates onboard and off-board sensor data. - Initiate development of coordinated multi-platform, multi-component waveforms. - Initiate development of a real-time electronic warfare support deinterleaving capability. - Initiate development of advanced communications emitter identification. Battlespace Sensor and Intelligence Integration: - Continue all efforts from FY 2008 less those noted as completed above. - Complete the development of a Case-Based Reasoning simulation/model for implementing situation, threat awareness fusion solutions and a Bayesian Network inference engine for manipulating uncertainty and learning from data.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete efforts in Joint Director of Laboratory's Data Fusion Model Level 1/2/3 data fusion using abductive reasoning, Bayesian networks, agent-based techniques, statistical-based methods, and other approaches. - Complete efforts in the automated integration of disparate sources of information that involve data mining methods and game theory. - Complete development of technology for improving voice data interpretation and presentation to cope with audio information overload in Navy Systems. - Initiate approaches and tools for (semi)-automated data integration and reasoning about information from diverse sources in ways that support decision makers with timely, actionable information at operational and tactical levels of command, with an emphasis on missions that are related to OCO and force protection. Automated Reasoning Methods and Models for Situational Analysis: - Continue all efforts from FY 2008 less those noted as completed above. - Complete ontology-based information fusion for enhanced situational awareness and classification-based knowledge discovery. Automated Decision Tools: - Continue all efforts from FY 2008 less those noted as completed above. - Complete sensor management algorithms that reduce the amount of labeled training data. - Initiate development of algorithms to optimize the selection from disparate and multiple information sources as well as the characterization of related pedigree over multiple user processing requests within extremely large data sets, including checks and balances between assignment, storage, search, quality, reliability, completeness, and latency. Secure Sensor Networks: - Continue all efforts from FY 2008 less those noted as completed above. - Complete the development of a 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.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete development of technology for improved steganography and watermarking. - Initiate development of improved separation technology for shared-hardware host execution environments to increase information security. *FY 2010 Plans:* - Automated Intelligence Tools: - Continue all efforts from FY 2009 less those noted as completed above. - Complete development of interactive image/video-based surveillance systems for perimeter protection, and port protection. - Initiate development techniques for image coding based on shapes and regions and their temporal evolution to facilitate image analysis as well as to enable efficient image transmission and restoration. Develop methods for efficient search of large image and video databases to facilitate automated, real-time image/video registration for surveillance applications, threat detection, and target geo-location. - Initiate development of mathematically rigorous techniques and algorithms for automated understanding of surveillance imagery, including background modeling to assist image context interpretation and multi-sensor characterization of complex scenes. Battlespace Sensor and Intelligence Integration: - Continue all efforts from FY 2009 less those noted as completed above. - Initiate development of tools and processes including higher level statistical methods, game theory, first order logic form, Bayesian networks, and fusion algorithms, to model enemy behavior and provide threat assessment, represent complex data patterns, and model the structure of context to improve the data fusion process. - Initiate demonstrations of ontologies in a maritime environment using an experimental testbed or limited technology experiments to validate new approaches to inference and higher-level fusion capabilities. - Initiate development of algorithms to generalize the characterization of ontologies and to integrate them, including machine processing compatibility to effectively link methods for visualization and human processing (UML methods) with machine and information exchange and processing (XML methods). Automated Reasoning Methods and Models for Situational Analysis:				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continue all efforts from FY 2009 less those noted as completed above. - Initiate development of techniques to uncover trends, links, hidden models, and relationships of behavior/activity that will lead to inferring intent and developing course-of-action (COA) alternatives. - Initiate development of robust reasoning methods supporting automated situational understanding for maritime domain awareness under time-critical constraints and uncertainty. - Initiate development of methods of grouping situations to categorize algorithms for reuse under a variety of conditions, including Naval situation recognition and categorization (used to group similar situational types); situation characterization to define threshold qualifications to “bin” situations within categories (abductive development as a threshold process); situation projection to develop techniques to characterize features necessary to classify a situation – counterfactuals and inductive development. Automated Decision Tools: - Continue all efforts from FY 2009 less those noted as completed above. - Complete the development of methods for selecting sensors and platforms for search and surveillance operations in a theater, allocating the selected sensors and platforms to specific missions, operating the allocated sensors during a mission, and fusing the information from the sensors and other sources. Secure Sensor Networks: - Continue all efforts from FY 2009 less those noted as completed above. - Initiate development of algorithms, secure protocols, architectures, software tools, languages, certification technologies, standards, guidelines to assure safe, secure, policy-compliant, interoperable systems for information transfer.					
HUMAN FACTORS AND ORGANIZATIONAL DESIGN The overarching objective of this activity is the achievement of FORCEnet and Sea Power 21 goals by developing human factors principles and cognitive models for human centric design, decision support systems for collaborative decision making, and adaptive command and control structures. The CNO’s new Maritime Strategy and the Commander Fleet Forces Command complementary plan to revise organization of Maritime Operations Centers (MOC) place high priority on the aforementioned FORCEnet and Sea Power 21 goals. Specific objectives focus on improving small team, platform, task force, and battle group		7.011	4.978	6.597	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
operations by developing advanced human factors technologies for incorporation into operational systems. The goals and payoffs are to enhance human performance effectiveness; improve the timeliness and quality of decision making; develop strategies to mitigate high workload and ambiguity; reduce manning; improve situational awareness and speed of command through a deeper understanding of human capabilities and limitations; and improvement of team decision making in ad-hoc, complex problem solving scenarios. The current specific objectives are: a) Human Computer Interaction/Visualization: Develop an understanding of the limitations of human perceptual and attentional systems in relation to maximizing user performance when interacting with complex Naval displays. A combination of computational cognitive modeling and psychological studies are employed to determine the capacity limitations on human performance that will undoubtedly have impact in reduced manning requirements, including information-rich weapons platforms. Develop technology for improving human interaction with autonomous systems and for improving virtual reality systems for training purposes. b) Collaboration and Knowledge Interoperability: Develop an understanding of the high-level cognitive processes underlying team knowledge processing, decision making and collaboration in order to improve team performance in the autonomous, agile, quick-response combat team of the future. Develop cognitive science-based tools, models, computational methods, and human-agent interfaces to enhance team collaboration effectiveness and team performance in complex problem solving teams. Specific objectives include application of discourse analysis methods and other process metrics to assess team performance. A conceptual model of team collaboration will be constructed and computational relationships among processes and team performance will be developed. Findings will be validated and demonstrated in operationally oriented testbeds by addressing issues including: rapid team analysis of large volume, uncertain data; knowledge interoperability in coalition ops; measures of team situational awareness; accelerated team synchronization; improved heterogeneous team performance; team collaboration performance metrics; cultural/language/experience-free representation and transfer of meaning. c) Organizational Design and Decision Support Systems: Develop quantitative executable models, task graphs and optimization algorithms for the organizational design of Maritime Operations Centers (MOC)				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
consistent with the Navy's New Maritime Strategy. Investigate through modeling and simulation human competency requirements for staffing MOC. Develop quantitative formalisms for monitoring and assessing the completeness, consistency and accuracy of rules of engagement (ROE). d) Social Network Analysis: Develop computational models and algorithms for the analysis of terrorist threats and counter-measures and strategies against terrorist threats. Develop new computational algorithms for the discovery of missing and hidden nodes in complex graphs applicable to the problem of understanding hidden information in terror networks. Develop new approaches to calculation of network completeness. Develop computational approaches to the study of factionalism in social movements using Islamist movements as exemplar data collectivities. The decrease from FY 2008 to FY 2009 reflects the completion of development of a user tool to counteract perceptual errors associated with 3D perspective-view visual displays, research on tools to assist in the management of task interruptions. The increase from FY 2009 to FY 2010 reflects new program research to support MOC and additional social and cultural modeling. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. *FY 2008 Accomplishments:* Human Computer Interaction/Visualization: - Continued application of cognitive architecture modeling to the design of interface analysis tools. - Completed development of a user tool to counteract perceptual errors associated with 3D perspective-view visual displays. - Completed research on tools to assist in the management of task interruptions. - Completed 3D audio experiments in the context of Common Enterprise Display System (CEDS) to evaluate cognitive models of 3D audio perception.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated research on the application of information architectures (DOD Architectures Framework), executable models (Petri Nets) and cognitive models to the systematic design of Human-Computer Integration. - Initiated effort to develop tools for more automated, cost-efficient modeling of human system interaction. - Initiated methods to introduce key cognitive abilities to autonomous vehicles that will enable warfighters and vehicles to work together more collaboratively. Collaboration and Knowledge Interoperability: - Continued evaluation of Latent Semantic Analysis (LSA) of operator communications as an effective metric of shared situational awareness in unmanned aerial vehicle control teams. - Continued demonstration of 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. - Continued developing jointly with the Naval Air Systems Command, 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. - Continued effort to improve response speed of the LSA tool to a near-interactive level and incorporate into a fleet experiment. Collected and evaluated data to validate improved speed and effectiveness of developing situational awareness. - Continued effort to incorporate the EWALL prototype into a simulation of the Tactical Operations Center of the Special Operations Forces and collected performance data to validate effectiveness. - Continued Sea Basing research on rehearsal for Expeditionary Strike Groups in the conduct of Maritime Interdiction Operations (MIO) and developed reach-back capability for computationally intense analysis for evaluating courses of action. - Initiated development of metrics to identify and measure the contribution to team performance of the cognitive processes underlying ad-hoc team decision making. - Initiated effort to improve the model of ad-hoc team decision making by including collaborative agent-based contribution to team performance. Organizational Design and Decision Support Systems:				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued model-based simulations and experiments to investigate the effectiveness of hierarchical organizational structures in network-centric operational environments in order to evaluate the implementation of FORCEnet concepts. - Continued deployment of models for Effects-Based Operations (EBO) aboard naval vessels to support Expeditionary Group One to conduct kinetic and non-kinetic tactical operations in a measured manner. - Continued jointly with the Air Force applied research on the integration of Information Operations in Air Control Centers. - Continued applied research on command and control adaptive architectures for Expeditionary Strike Groups working with OPNAV and Expeditionary Strike Group ONE, San Diego. - Initiated research on adaptive command and control architectures in support of the Navy's new Maritime Strategy. Social Network Analysis: - Continued development of new threat scenarios incorporating Joint Force Maritime Component Commander operations, counter-insurgency and humanitarian operations with the staff of the Naval War College. These new threat scenarios will provide the basis for Limited Objective Experiments in the Innovation Laboratory at the Naval War College. - Continued development of Dynamic Network analysis (a terrorist network analysis tool) in operational command setting at U.S. Pacific Command. - Continued the improvement of terror network analysis decision tools for combatant command use and military planning, including testing of tools, development of metrics, and validation. - Continued the development of advanced computational models capable of analyzing multi-dimensional networks of thousands of nodes. Current capabilities enable the analysis of networks consisting of hundred of nodes. - Continued the development of computational models of influence that incorporate the social structure, values and cultural processes of urban non-western communities for achieving post-conflict stabilization. - Continued the development of social network models to model the human element in maritime domain awareness.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated research on advanced computational models to incorporate additional capabilities in the analysis of terror networks and on various types of flow in these networks (such as the flow of expertise, resources). - Initiated effort to improve social network models to analyze merchant marine traffic. *FY 2009 Plans:* Human Computer Interaction/Visualization: - Continue all efforts of FY 2008 less those noted as completed above. Collaboration and Knowledge Interoperability: - Continue all efforts of FY 2008 less those noted as completed above. - Initiate development of a computational model of subjective reasoning for course of action selection activity in distributed, asynchronous teams. - Initiate test and validation of a cognitive processes model of team collaboration in a Maritime Interdiction Operations domain. - Initiate integration of high-level planning and computational cognition with low-level to enhance situational awareness via swarm-based sensor platforms. Organizational Design and Decision Support Systems: - Continue all efforts of FY 2008 less those noted as completed above. - Initiate research on quantitative formalisms for developing and assessing the completeness, consistency and accuracy of rules of engagement (ROEs). - Initiate research on executable models and optimization algorithms for adaptive command structures that are congruent with mission requirements to support the design of Maritime Headquarters with Maritime Operations Centers (MHQ/MOC) organizations. - Initiate research on models to support the design of scalable joint and coalition Maritime Operations Centers that allocate responsibilities to elements afloat and ashore. Social Network Analysis: - Continue all efforts of FY 2008 less those noted as completed above.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiate human cultural and social modeling to improve warfighting, civilian military operations and humanitarian operations in non-Western environments. *FY 2010 Plans:* Human Computer Interaction/Visualization: - Continue all efforts of FY 2009. - Initiate development of a testbed for validating cognitive models of operator performance in cross-modal (audio/visual) task environments. Collaboration and Knowledge Interoperability: - Continue all efforts of FY 2009. - Initiate research on the use of metaphors and temporal mental models to improve representation and transfer of meaning in ad-hoc, complex team problem solving with the objective of enhancing team collaboration effectiveness and team performance. - Initiate validation of a conceptual model of macrocognition in teams. Scenario-based experimentation will define the presence, persistence and relevance of individual and team cognitive processes and relationships among those processes. Deliverable will be a computational understanding of how teams collaborate to reach consensus. Organizational Design and Decision Support Systems: - Continue all efforts of FY 2009. - Initiate, in cooperation with the Air Force, the capability to examine human competency requirement in offensive and defensive cyber operations and the effects of courses of action at the tactical and operational level. The research would be conducted using DOD and academic laboratories capable of high fidelity mission simulation and precise measurements of independent and dependent measures. Social Network Analysis: - Continue all efforts of FY 2009.				
KNOWLEDGE SUPERIORITY AND ASSURANCE	29.468	18.485	25.755	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
This activity is devoted to midterm technology development in close concert with programs of record. The products of these efforts are expected to transition at the end of their schedule into the associated program of record. The Future Naval Enabling Capabilities in this activity span across the Information Infrastructure, Applications/Tools/Decision Aids, Command and Control, Apertures and Radios, and Tactical Networks and Network Control/Management technology areas. Technologies being developed will integrate sensors, networks, decision aids, weapons and supporting systems into a highly adaptive, human-centric, comprehensive maritime system. This system will operate from the sea bed to space in a Service Oriented Architecture that can be used in a Joint Environment. The current specific objectives are: a) Combat ID Information Management of Coordinated Electronic Surveillance - Develop software algorithms and techniques for the purpose of dynamically re-tasking organic sensors in conjunction with fused intelligence products to support Command Control and Combat Systems. Efforts will include developed capability for automated integration of multi-intelligence surveillance & reconnaissance of red, white, and blue force locations for Combat Identification by providing software integrated into Navy and Marine Corps Command Control and Combat Systems. b) Automated Control of Large Sensor Networks - Develop smart tactical sensors/platforms and software algorithms for automated and mission specific tactical sensor fields capable of fulfilling specific mission objectives with smart sensors that forward knowledge vice raw data. c) OCO Focused Tactical Persistent Surveillance - Develop agile and enhance tactical sensors for a netted, organically controlled, adaptive sensor field that is capable of detecting and classifying features relevant to the global war on terror to include organic sensors for small tactical expeditionary units, capable of supporting the dynamic character of modern operations from the highly mobile to the long-term. d) Globally Netted Joint/Coalition Force Maritime Component Commander - Develop automated tools and software to capture and share information for ‘globally-networked, theater-focused’ maritime capabilities that will enhance Joint Task Force (JTF) and COCOMs’ ability to execute their intentions.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
e) Dynamic Tactical Communications Networks - Develop dynamically adaptive automated software algorithms, protocols, and network management techniques that provide a self-organizing networking capability. This capability will adapt to available links of opportunity at lower echelons and assure priority movement of critical data intra-network and through reachback gateway networks that interface with the Global Information Grid (GIG). f) Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC) - Develop software for command control and combat systems that will provide the maritime commander agile and responsive control and management of tactical Antisubmarine Warfare (ASW) and interactions in a net centric enterprise environment. Focus will address classified ASW requirements for command and control at the tactical level. g) High-bandwidth Free-space Lasercomm - Develop, integrate and demonstrate free-space optical terminals and retro-reflector optics that are designed to provide an affordable, reliable and high-bandwidth Free-Space Laser Communications (Lasercomm) capability which is adaptive and agile in mitigating a wide range of atmospheric and maritime turbulence, precipitation and obscuration conditions. This capability will enable surface and airborne platforms to exchange very high bandwidth information in Navy Tactical Networks, even with limited SATCOM or RF spectrum access. h) Actionable Intelligence Enabled by Persistent Surveillance - Develop analysis tools and software that will provide accurate threat detection by exposing the enemy's vulnerabilities, unmasking their latent networks, discovering their tactics, techniques, procedures and exploiting in new ways the vast amount of sensor data available today against an irregular threat. Also develop the following: An electro-optical, infrared and laser Intelligence, Surveillance, and Reconnaissance Targeting (ISRT) optics technology, capable of wide Field of View/Field of Range (FOV/FOR) at variable resolution & pointing direction, for installation in mobile platforms without gimbals; a light weight, low cost sensor suite and autonomy algorithms to enable detection and avoidance of all classes of aircraft or Unmanned Aerial Vehicles (UAV).				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
i) Real-Time Long Range Air Defense Combat ID in Support of Early Engagements - Develop algorithms and open architecture compatible software that will provide real-time long range air defense combat ID in support of early engagements. Specific efforts support Naval Integrated Fire Control - Counter Air (NIFC-CA) capability by enabling fleet Theater Missile Air Defense (TAMD) units to use real-time and non-real time sensor and ISR data to rapidly build ID on long-range contacts. The decrease from FY 2008 to FY 2009 is due to completion of FNC efforts to develop object-level data fusion algorithms to improve maritime common operational picture development in a service oriented architecture environment, and the development of technologies for smart tactical sensors, platforms, and algorithms in an urban/cluttered environment. The balance of the reduction reflects a reduced level of investment in ongoing efforts to fund higher priority requirements. The increase from FY 2009 to FY 2010 is due to the initiation of new FNC efforts to develop tools and software that will increase the commander's ability to predict threats and support weapons allocation. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. *FY 2008 Accomplishments:* Combat ID Information Management of Coordinated Electronic Surveillance: - Continued the Electronic Warfare Integrated System for Small Platforms (EWISSP) effort by exploration and refinement of the subsystem interface software that will operate via Versa Module Eurocard (VME)-64 and Recommend Standard (RS)-422 buses. - Continued Actionable Information from Multiple Intel Sources in a Global Information Grid Enterprise Services (GIG-ES) Environment. Provides automated integration of multi-INT surveillance and reconnaissance of red, white, and blue force locations for Combat ID by providing software integrated into Navy and Marine Corps Command Control & Combat Systems; order of magnitude less false recognition; and identification of significant military entities consistent with sensor capabilities. - Continued developing and testing airborne and shipboard battle manager platforms for UAVs operating from Littoral Combat Ships. Continued developing and began testing an open architecture airborne control station that can be used onboard a P-3 type aircraft for the control of multiple UAVs.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued the all-source track and identity fusion effort integrating a broad range of intelligence product information including: Kinematic Radar Reports, Organic and UAV imagery, electronic and communications emissions and human spot reports for tactical and organic sensors to be augmented with national sensors. Automated Control of Large Sensor Networks: - Continued design of tools enabling mission-specific tactical sensor fields for at least two separate mission areas. - Continued design of tactical distributed data analysis and automated indications and warnings for 50% of tactical data. - Continued design of automated tactical platform and sensor planning and management sufficient for one operator to control multiple sensors. - Continued investigation of human to tactical sensor field interface to enable the user to locate relevant knowledge within 3 minutes. - Continued development of automated and mission aware large tactical sensor management engines and irregular threat and tactical sensor ontologies. - Continued development of the agents and other analysis applications enabling a fully netted tactical battlespace. OCO Focused Tactical Persistent Surveillance: - Completed investigation of smart tactical sensors, platforms, and algorithms in an urban/cluttered environment for at least 2 sensing modalities. Globally Netted Joint/Coalition Force Maritime Component Commander: - Completed development of object-level data fusion algorithms to improve maritime common operational picture development in a service oriented architecture environment. *FY 2009 Plans:* Combat ID Information Management of Coordinated Electronic Surveillance: - Continue all efforts of FY 2008.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Automated Control of Large Sensor Networks: - Continue all efforts of FY 2008. Globally Netted Joint/Coalition Force Maritime Component Commander: - Initiate effort to develop and apply emerging technologies that support delivery of Navy-approved FNC enabling capabilities structured to close operational capability gaps that involve the common picture. - Initiate packaging of emerging common picture technologies into deliverable FNC products and ECs that can be integrated into acquisition programs within a five year period. - Initiate efforts for the mature common picture technologies that support naval requirements identified within the FORCEnet naval capability pillar. Dynamic Tactical Communications Networks: - Initiate effort to develop and apply emerging technologies that support self organizing networking and assured communications exchange in tactical communications networks. Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC): - Initiate effort to develop new, and leverage emerging, technologies that support dynamic and response management and control of net-centric enterprise theater and tactical ASW operations. This includes automation support for synchronized planning of resources and multi-mission execution, and access and shared awareness of data activities and status among Maritime Operation Centers and tactical forces in a tactical, netted service-oriented architecture (SOA) environment. *FY 2010 Plans:* Combat ID Information Management of Coordinated Electronic Surveillance: - Continue all efforts of FY 2009. - Initiate demonstrations of the adaptation of fusion and resource management capabilities directly into Distributed Information Operations-Service (DIO-S). Automated Control of Large Sensor Networks:				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continue all efforts of FY 2009. - Initiate demonstrations of mission-aware planning tools that allow large sensor networks to support tactical operations. OCO Focused Tactical Persistent Surveillance: - Initiate development of high information tactical agile sensors, including tactical RF sensors, sensors to sense the state of a person and smart tactical imagers and acoustic sensors. Globally Netted Joint/Coalition Force Maritime Component Commander: - Continue all efforts of FY 2009. - Initiate development of fusion algorithms and methods that support building and maintaining large distributed databases; implementing GIG-compliant data strategies; mediating and integrating across heterogeneous databases; accessing and discovering authenticated users and brokering agents; and identifying ambiguities or inconsistencies for additional sensing and processing. Dynamic Tactical Communications Networks: - Continue all efforts of FY 2009. - Initiate development of distributed-and dynamic policy based network management, secure mobility management solutions, and network service discovery mechanisms. - Initiate development of robust and bandwidth efficient group communication protocols for the tactical environment, including disruption tolerance and inter-domain (security and routing) protocols for fully-connected domains. Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC): - Continue all efforts of FY 2009. - Initiate development of tools and algorithms that support automated data access, shared awareness, and automated synchronized planning, coordination and execution of network enterprise resources among tactical units with limited/degraded communications. High-bandwidth Free-space Lasercomm:				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate development of mitigation techniques for laser beam propagation through atmospheric turbulence and aerosol obscuration. - Initiate development of and demonstrate technologies that support high bandwidth laser communications, including fast acquisition and fine beam steering/tracking algorithms; wide-area avalanche photo-diode receive array techniques; and high bandwidth wide field-of-view retro-reflector optics. Actionable Intelligence Enabled by Persistent Surveillance: - Initiate development of advanced analysis tools that are relevant to the information needs of tactical warfighters engaged against irregular actors. - Initiate development of a multi-modal tactical wide area surveillance payload and sensors relevant to tier-2 UAVs that can detect other airborne platforms.					
MULTI-SOURCE INTEGRATION AND COMBAT IDENTIFICATION This activity addresses theater air and missile defense (TAMD), and responds to warfighter 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. It supports the Sea Shield Pillar Enabling Capability of Real Time Long Range Air Defense CID in Support of Early Engagements and related CID Science & Technology to be worked under the FORCEnet FNC. The increase between FY 2008 and FY 2009 is to support completion of research for networked sensors. The decrease between FY 2009 and 2010 reflects the completion of the CID effort. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. *FY 2008 Accomplishments:* - Continued development of a robust test environment to elucidate the design principles of human and sensor network interactions.		1.893	3.183	1.005	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued effort to improve the resolution of the High Frequency Relocatable Over-the-Horizon Radar (HF-ROTHR) more than two orders of magnitude using time-reversal methods. *FY 2009 Plans:* - Continue all efforts of FY 2008. - Complete development of a robust test environment to elucidate the design principles of human and sensor network interactions. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above.					
TACTICAL SPACE EXPLOITATION The Tactical Space Exploitation initiative explores the application of new space craft 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 and communications payload technology deployed on satellites to demonstrate augmented mobile satcom capabilities over a theater. Development of payload and bus technologies that will serve as building blocks for future responsive space systems: payloads, bus technologies and, significant space robotic technologies that address on-orbit inspection, servicing, repair and assembly, and mission-life extension. The decrease between FY 2008 and FY 2009 is the result of investments in this activity being curtailed in response to completion of the development of a communications satellite payload to provide augmented mobile satcom over a theater from high altitude earth orbit with payload launch in late FY 2008. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.		22.699	16.719	16.048	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2008 Accomplishments: - Continued development of integration plans, algorithms, and satellite concept of operations to demonstrate the integrated signals payload as a secondary payload on a FY 2008 small satellite launch. - Continued development of small multifunctional integrated signals electronics systems for ship tracking from space and two-way data exfiltration from distributed global sensors. - Continued development of a satellite-borne electro-optical sensor system for FY 2009 launch to the International Space Station to test new techniques for surveillance of environments and targets of naval interest for anti-submarine warfare and mine warfare. - Continued program to use chemical release from satellites launched into selected low-Earth orbits to de-populate intense trapped electrons in radiation belts following a low-altitude nuclear explosion in space. - Completed development and launch of communications satellite payload to provide augmented mobile satcom over a theater from high altitude earth orbit. - Initiated the development of a highly capable self-inspection vehicle for spacecraft with large complex deployables. - Initiated the development of a preliminary design for electrodynamic propulsion technology demonstration spacecraft. *FY 2009 Plans:* - Continue all efforts of FY 2008 less those noted as completed above. - Complete and launch maritime hyperspectral payload on TacSat or Space Test Program (STP) satellite. Develop improved maritime hyperspectral payload for flight on the International Space Station through STP. Complete analysis of TacSat 3 data. - Initiate effort to develop technologies using autonomous bi-dexterous manipulation for close-proximity operations in space. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. - Complete Comm-X payload and launch it aboard TACSAT 4 satellite.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0204152N/E-2 Squadrons									Continuing	Continuing
PE 0205601N/HARM Improvement									Continuing	Continuing
PE 0206313M/Marine Corps Communications Systems									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602114N/Power Projection Applied Research									Continuing	Continuing
PE 0602123N/Force Protection Applied Research									Continuing	Continuing
PE 0602131M/Marine Corps Landing Force Technology									Continuing	Continuing
PE 0602204F/Aerospace Sensors									Continuing	Continuing
PE 0602236N/Warfighter Sustainment Applied Research									Continuing	Continuing
PE 0602271N/ Electromagnetic Systems Applied Research									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000	
PE 0602702F/ Command Control and Communications			
PE 0602782A/Command, Control, Communications Technology		Continuing	Continuing
PE 0603114N/Power Projection Advanced Technology		Continuing	Continuing
PE 0603123N/Force Protection Advanced Technology		Continuing	Continuing
PE 0603235N/Common Picture Advanced Technology		Continuing	Continuing
PE 0603236N/Warfighter Sustainment Advanced Technology		Continuing	Continuing
PE 0603271N/ Electromagnetic Systems Advanced Technology		Continuing	Continuing
PE 0603609N/ Conventional Munitions		Continuing	Continuing
PE 0603640M/USMC Advanced Technology Demonstration (ATD)		Continuing	Continuing
PE 0603658N/Cooperative Engagement		Continuing	Continuing
PE 0604307N/Surface Combatant Combat System Engineering		Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602235N COMMON PICTURE APPLIED RESEARCH	PROJECT NUMBER 0000

PE 0604518N/Combat
Information Center
Conversion

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Performance metrics are discussed within the R2a.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	100.864	115.700	104.169						Continuing	Continuing
0000: WARFIGHTER SUSTAINMENT APPLIED RESEARCH	100.864	115.700	104.169						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE supports the Future Naval Capabilities (FNCs) of Littoral Combat/Power Projection, Capable Manpower, Force Health Protection Future Capability, and Enterprise and Platform Enablers (EPE) FNC; 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; 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." FY 2008 reflects the reinitiation of Human Systems Integration efforts to develop automation, human interface, and decision support technologies (funded in FY 2005 and prior).

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

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	107.564	93.862	92.068	
Current BES/President's Budget	100.864	115.700	104.169	
Total Adjustments	-6.700	21.838	12.101	
Congressional Program Reductions		-0.335		
Congressional Rescissions				
Total Congressional Increases		22.240		
Total Reprogrammings	-5.665			
SBIR/STTR Transfer	-1.035			
Program Adjustments			12.041	
Rate/Misc Adjustments		-0.067	0.060	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **ACOUSTIC RESEARCH DETACHMENT TEST SUPPORT PLATFORM UPGRADE**	0.000	1.496
Project: 9999, **ADVANCED COMPOSITE MARITIME MANFACTURING**	0.000	1.995
Project: 9999, **ADVANCED REINFORCED MATERIALS AND NEW MATERIALS RESEARCH FOR AIRCRAFT TIRES**	0.968	0.000
Project: 9999, **AMELIORATION OF MILITARY HEARING LOSS**	0.772	0.000
Project: 9999, **ASSISTIVE TECHNOLOGIES FOR INJURED SERVICEMEMBERS**	0.000	1.596
Project: 9999, **ATMOSPHERIC WATER HARVESTING**	0.966	0.000
Project: 9999, **BIOSENSORS FOR DEFENSE APPLICATIONS**	1.928	1.994
Project: 9999, **COMPOSITE MATERIALS ENHANCEMENTS THROOUGH POLYMER SCIENCE RESEARCH AND DEVELOPMENT**	0.000	2.235
Project: 9999, **DIGITAL DIRECTED MANUFACTURING PROJECT**	1.240	1.695
Project: 9999, **DURABILITY OF COMPOSITE MATERIALS AND STRUCTURES**	1.544	0.000
Project: 9999, **FRICTION STIR WELDING**	0.000	0.798
Project: 9999, **INTELLIGENT RETRIEVAL OF IMAGERY**	0.000	2.393
Project: 9999, **MAST-MOUNTED IN PORT VIDEO FORCE PROTECTION SURVEILLANCE SYSTEM**	1.547	0.000

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **MINIATURIZATION, SYSTEMIZATION OF SEMICONDUCTING METAL OXIDE**	0.773	0.000
Project: 9999, **MISSION DEPLOYABLE SURVEILLANCE BIOMETRICS**	1.545	0.000
Project: 9999, **NANOTECHNOLOGY ENGINEERING & MANUFACTURING OPERATION (NEMO)**	0.776	1.596
Project: 9999, **NANOTECHNOLOGY RESEARCH**	3.858	0.000
Project: 9999, **ON-BOARD VEHICLE POWER SYSTEMS DEVELOPMENT**	0.000	2.393
Project: 9999, **OPTIMIZATION OF NEW MARINE COATINGS**	1.932	1.596
Project: 9999, **PULSE VIRTUAL CLINICAL LEARNING LAB**	2.314	2.393

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH					PROJECT NUMBER 0000	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
0000: WARFIGHTER SUSTAINMENT APPLIED RESEARCH	100.864	115.700	104.169						Continuing	Continuing

A. Mission Description and Budget Item Justification

This PE supports the FNC's of Littoral Combat/Power Projection, Capable Manpower, Force Health Protection Future Capability, Enterprise and Platform Enablers (EPE) FNC; 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 and education; human systems integration; littoral combat and power projection capabilities; advanced naval materials; medical technologies; environmental quality; biocentric technologies; high speed sealift; cost reduction technologies; and Sea Basing 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
ADVANCED NAVAL MATERIALS	8.163	13.068	15.132	

Advanced Naval Materials efforts include: developing advanced, high-performance materials; processes to reduce weight and cost; and enhanced sonar transducers.

The increase between FY 2008 and FY 2009 reflects the initiation of new applied research in Naval Structural Health Monitoring and Corrosion Control Prevention Technologies and transition of cost reduction technology efforts to this activity. The increase between FY 2009 and FY 2010 is due to OSD directed funding increase to S&T.

FY 2008 Accomplishments:

- Continued multi-laser-processing technique development for the fabrication of ultra hard materials for wear resistance applications.
- Continued development of advanced, cost-efficient joining of titanium for >25% weight reduction of large seaborne structures.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued development of advanced composites and polymers with fire resistance for ship structures. - Continued development of nanotube reinforced composite materials for next generation air and naval platforms. - Continued development of acceptance testing methodologies for advanced transducer single-crystal high-strain materials and definition of standardized materials properties and composition ranges. - Continued development of compositional tuning of single-crystal, high-strain transducer materials, for specialized naval system applications. - Continued development of cavitation resistant ship rudder coatings based on the FY 2004 shipboard coating study. - Continued marine titanium alloy design and processing development, exploiting anticipated cost reductions for high performance, reduced maintenance naval applications. - Continued development of continuous single wall carbon nanotube composite materials for next generation air and naval platforms. - Continued stainless steel carburization study to enhance corrosion performance. - Continued development of surface preparation methods and characterization of corrosion performance for future naval ship materials. - Continued evaluation of low temperature carburized materials for marine application. - Continued development of coating performance and knowledge database for Naval use. - Continued development of mechanistic model for stress corrosion cracking in Nickel Aluminum Bronze (NAB). - Continued friction stir welding development for control of residual stresses and elimination of distortion in naval steels. – Continued development of innovative sonar transducers based on high-strain, high-coupling piezoelectric single crystals. - Continued development of solid-state growth methods for making high-strain, high-coupling piezoelectric single crystals. – Continued development of integrated structural composites with blast resistance, manufacturing technologies, and low-cost organic resins with improved fire resistance.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued development of novel processing technologies for increasing the fatigue strength and corrosion resistance of weldments for ship structures with reduced weight and maintenance requirements. - Completed evaluation of corrosion performance on the family of conjugated poly (phenylenevinylene) polymers. - Completed development of techniques and procedures to enhance hot corrosion and oxidation resistance. - Completed development of Microbiologically Influenced Corrosion (MIC) resistant passive alloys for sea basing. - Completed development of multifunctional transducer material, high-force high-strain actuators; and evaluation of advanced transducer single crystal high-strain materials. - Completed development of welding processes and consumables for high-nickel containing naval steels. - Completed development of phthalonitrile based organic resin material and hybrid composite development with improved fire resistance; and process development of fiber reinforced foam material. - Completed catalyst development and grow vertically aligned carbon nanotubes in existing gated silicon post structures in a DC plasma CVD reactor, obtaining stable field emission and 1 ampere/cm2 current densities. - Initiated development of materials processing methods for single crystal piezoelectrics to make strong, robust sonar transducers. - Initiated modeling and process development of single-melt cold hearth casting of naval titanium alloys including Ti 5-1-1-1 for enhanced mechanical properties and formability. - Initiated development of models and characterization methods for dynamic loading (water slamming and blast loading) in polymer composite materials. - Initiated ballistic test program to assess dependence of penetration velocity on coating thickness and substrate properties. - Initiate acoustic damping coatings for ship tank application. *FY 2009 Plans:* - Continue all efforts of FY 2008 less those noted as completed above.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete development of compositional tuning of single-crystal, high-strain transducer materials, for specialized naval system applications. - Initiate development of novel growth methods to specialized single crystal transducer materials tuned to requirements of specialized naval systems. – Initiate development of new 3D mechanical characterization technique for polymer composites based on dissipative energy density principles. – Initiate development of continuous based monitoring techniques of new synthetic fuels and lubricants based on electromagnetic signature analysis. – Initiate development and application of distributed fiber optic Bragg gratings for structural health monitoring of ships and aircrafts. - Initiate assessment of the degree of sensitization potential of marine grade Al alloys. - Initiate investigation of criteria for stable pitting of stainless steel. - Initiate development of surface assessment technologies to measure surface profile and chlorine. - Initiate evaluation of advanced material coating for erosion control on helicopter main rotor blade leading edges. The following efforts transition from Cost Reduction Technologies in this PE in FY 2009: - Continue development of portable, real-time, Non-Destructive Examination (NDE)/Non-Destructive Inspection (NDI) technology for heat damage detection in composite materials. - Continue development of fiber-optic Bragg grating demodulation system for structural health monitoring of ships and submarines. - Continue development of a revolutionary new thermal spray technology for repair and refurbishment of worn and/or corroded components on ships, aircraft and combat vehicles. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete ballistic test program to assess dependence of penetration velocity on coating thickness and substrate properties. - Initiate development of seamless joining technologies for large, complex shaped conventional ceramic windows from small, inexpensive components using electorphoretic deposition of ceramic nanoparticles.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate development of intelligent corrosion sensor systems for intergranular corrosion cracking. - Initiate studies on fuel cell corrosion. - Initiate development of superhydrophobic surface modification technology. - Initiate studies on mitigation of pitting corrosion and stress corrosion cracking in marine aluminum alloys.					
BIOCENTRIC TECHNOLOGIES Biocentric technologies provide novel solutions for naval needs based upon the applications of biosensors, biomaterials, and bioprocesses. Topic areas include, but are not limited to development of biologically-based signal processing for medical, surveillance and security applications; bioinspired robotics; microbial or plant engineering to produce high-value naval materials such as energetic compounds or to develop sentinel organisms, and marine mammal diagnostics to support the Navy's Fleet Marine Mammal Systems. The increase from FY 2008 to FY 2009 is due to the initiation of new efforts for advanced biometric sensing for autonomous systems, chemical sensing, and micro-bio-fuel cells for autonomous vehicles. *FY 2008 Accomplishments:* - Continued engineered microbial synthesis and processing of energetic materials. - Continued development of innovative naval biosensors, biomaterials, and bioprocess technology (i.e., engineered plants for explosives detection, study of human stress biomarkers and bioinspired panoramic imaging systems). - Continued efforts on naval biosensor to detect brain structures and blood vessels through skull bones. - Continued efforts on innovative marine mammal diagnostics to detect viruses, bacteria, fungi and immunomarkers. - Continued, developed and demonstrated methods for determining multiple microbial genetic sequences which will have profound implications for detection of environmental pathogens and marine sensory systems using microorganisms.		5.640	5.786	5.491	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued program to aid warfighter protection that will provide versatile systems for tagging and tracking using chemical tangents tailored to simultaneously satisfy operational requirements and match optical or physio-chemical detection methods. - Continued a program to develop a microfabricated analytical system for trace detection of illicit materials including explosives, and other hazardous chemicals. - Continued biomimetic signal processing efforts, such as temporal and temporal pattern recognition for security breaching noise detection and biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing algorithms. - Continued efforts in bioinspired quiet, and maneuverable self-propelled line array using high-lift propulsors based on animal wing and fin biomechanics. - Continued engineering development and optimization of sea-floor sediment energy harvesting system for sustainable and autonomous powering of underwater sensor networks. - Initiated effort to power AUV recharging station using (sediment) microbial fuel cell. - Initiated effort to develop single domain antibodies for the recognition of explosives and small toxins. *FY 2009 Plans:* - Continue all efforts of FY 2008. - Continue marine mammal immunomarker efforts, including the characterization of the dolphin fore-stomach microbial community, identification of probiotic immunostimulating species and immunobioassays for stress and infection detection. - Complete biomimetic temporal pattern recognition for security breaching noise detection and biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing algorithms. - Complete development of an initial set of molecular diagnostic tests for bacterial, fungal and viral pathogens of marine mammals. - Complete program to aid warfighter protection that will provide versatile systems for tagging and tracking using chemical tangents tailored to simultaneously satisfy operational requirements and match optical or physio-chemical detection methods. - Initiate efforts on advanced biomimetic sensing and neural control for human-robot interaction to enable effective collaboration of warfighters and autonomous systems.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate development of underwater chemical sensors powered by sediment fuel cell. - Initiate research for detection or mitigation of microbes or compounds of naval relevance in various settings. - Initiate micro-bio-fuel cell efforts for implanted or micro-autonomous vehicles. - Initiate integration of biomimetic sonar with bioinspired autonomous undersea vehicles (with high-lift propulsors) to achieve closed loop control. - Initiate effort to develop living fluidic networks. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete research on microbial synthesis of phloroglucinol, an energetic material precursor. - Complete effort to develop and demonstrate methods for determining multiple microbial genetic sequences which will have profound implications for detection of environmental pathogens and marine sensory systems using microorganisms. - Complete development of a microfabricated analytical system for trace detection of illicite materials including explosives, and other hazardous chemicals. - Initiate development of a second set of molecular diagnostic tests for recently discovered viral, bacterial, and fungal pathogens of marine mammals.					
COST REDUCTION TECHNOLOGIES Cost Reduction Technology efforts include: developing 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 for materials. Investments under this activity were previously reported under Advanced Naval Materials and were broken out to provide improved clarification of the overall investment scope. The decrease from FY 2008 through FY 2010 is due to FNC EPE-FY10-03 being pushed out and a decrease for Accounting Management Reduction.		11.516	9.340	8.264	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2008 Accomplishments: - Continued development of ceramic matrix composite turbine blades for gas turbine engines. - Continued development of portable, real-time, Non-Destructive Examination (NDE)/Non-Destructive Inspection (NDI) technology for heat damage detection in composite materials. (Transitions to Advanced Naval Materials activity in this PE in FY 2009) - Continued development of cavitation resistant ship rudder coatings. - Continued development of fiber-optic Bragg grating demodulation system for structural health monitoring of ships and submarines. (Transitions to Advanced Naval Materials activity in this PE in FY 2009) - Continued development of a revolutionary new thermal spray technology for repair and refurbishment of worn and/or corroded components on ships, aircraft and combat vehicles. (Transitions to Advanced Naval Materials activity in this PE in FY 2009) - Initiated development of durable alloys and materials for shipboard and aircraft gas turbine engines and spallation-resistant thermal barrier coatings for shipboard/aircraft marine gas turbine hot sections. - Initiated development of advanced materials and processes for high temperature marine turbine disks and combustors. - Initiated development of oxidation and vanadium/sulfate-resistant high temperature coatings for shipboard/aircraft gas turbine engines. - Initiated development of calcium magnesium aluminum-silicate (CMAS)-resistant coatings for ceramic matrix composites. - Initiated development of high temperature foil bearing coatings for aircraft engine weight reduction. - Initiated development of high temperature organic matrix composites. - Initiated development of low-platinum and platinum-free aluminide coatings that are phase compatible with turbine blade alloys and exhibit low oxidation rates. - Initiated efforts to assess manufacturing issues and reliability of ceramic matrix composites for turbine engines. - Initiated integrated development of durable thermal barrier coating system with various bond coats for naval aircraft gas turbine hot section. - Initiated development of materials processing for future gas turbine molybdenum-based alloys. - Initiated efforts to conduct warfighter sustainment applied research, including technology management of investments supporting the naval enterprise and naval capability pillars.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

- Initiated efforts to perform technology analyses to support the development and validation of FNC technology performance metrics for enabling capabilities structured to close naval capability gaps.
- Initiated efforts to assess technology options for the development of applied FNC technologies packaged into deliverable science and technology products.
- Initiated applied research and development of improved coatings for (1) non-skid surfaces, (2) ship rudders, (3) high performance ship topsides, and (4) high performance airfield pavements.
- Initiated efforts for the development of technologies supporting automated shipboard assembly of air-delivered weapons. (Transitions to Sea Basing Technologies activity in this PE in FY 2009)
- Initiated analytical model and reduced scale component development of shipboard compact power conversion technologies for multi-function motor drives, bi-directional power conversion modules, and power management controllers, focusing on closing technology gaps associated with Alternative Integrated Power System Architectures. (This effort transfers to PE 0602123N in FY 2009)

FY 2009 Plans:
- Continue all efforts of FY 2008.
- Initiate applied research in determining lifting of hot section materials exposed to alternative synthetic fuels and petroleum-synthetic fuel blends.
- Initiate applied research development of Calcium Magnesium Aluminum-Silicate (CMAS)-resistant coatings for molybdenum-base alloys.
- Initiate life prediction research for modeling of hot section gas turbine materials, including blades, in mixed naval environments.
- Initiate development of an Adaptive Expert System to automatically and rapidly analyze aircrew performance (1M+ flight hours annually) to detect human factors related mishap leading indicators using a new technique with anomaly detection and corroboration.

FY 2010 Plans:
- Continue all efforts from FY 2009.
- Complete integrated development of durable thermal barrier coating system with various bond coats for naval aircraft gas turbine hot section.
- Initiate durable environmental barrier coatings for 2700F ceramic-matrix composites.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate research on Nb-Cr-Si alloys for improved corrosion resistance at high temperatures. - Initiate, develop and apply emerging technologies that support delivery of Navy. approved FNC enabling capabilities structured to close operational capability gaps in warfighter sustainment. - Initiate package emerging warfighter sustainment technologies into deliverable FNC products and ECs that can be integrated into acquisition programs within a five year period. - Initiate and develop mature warfighter sustainment technologies that support naval requirements identified within the Naval Power 21 capability pillars.					
ENVIRONMENTAL QUALITY Environmental Quality technologies enable sustained world-wide Navy operations in compliance with all local, state, regional, national and international laws, regulations and agreements, and support the Navy Transformational Roadmap in the areas of Sea Basing, Sea Strike and Sea Warrior. Compliant operations enable training evolutions and exercises that are critical for maintaining readiness. *FY 2008 Accomplishments:* - Continued development of new, advanced, environmentally benign AF/Anti-Corrosive (AC) coating systems for Navy platforms, far-term noise and air pollution emissions abatement technology for unrestricted operations, and multiple aqueous metal ion sensor to incorporate copper sensor developed in the Strategic Environmental Research and Development Program (SERDP) program for planned combined transition to the Environmental Security Technology Certification Program (ESTCP). – Continued initial development of robotic Hull Biomimetic Underwater Grooming (BUG) and associated grooming approaches. - Continued development of advanced environmentally sound technologies for shipboard waste treatment and pollution abatement systems. - Continued pilot scale system development of miniature gasification process for treatment of shipboard solid waste.		2.284	3.141	3.109	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued and completed initial decision report on impact of synthetic lubricants on shipboard oily waste treatment systems. – Completed alternate torch technologies for shipboard plasma waste treatment. - Completed report on cost benefit analysis of improved hull coatings and technologies for prevention of marine fouling. – Initiated development and modifications to shipboard oily waste treatment systems to accommodate processing of synthetic lubricants. *FY 2009 Plans:* – Continue all efforts of FY 2008 less those noted as completed above. – Complete development of the Mobile Cleaning Recovery and Recycling System (MCRRS) vehicle for cleaning of aircraft non-skid decks as a part of advanced environmentally sound technologies for shipboard waste treatment and pollution abatement systems. – Complete initial development of robotic Hull BUG and associated grooming approaches. – Initiate field evaluation of prototype robotic Hull BUG to identify gaps needed to refine and advance the technology. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. - Complete pilot scale system development of miniature gasification process for treatment of shipboard solid waste. - Complete far-term noise and air pollution emissions abatement technology for unrestricted operations. - Complete multiple aqueous metal ion sensor to incorporate copper sensor developed in the Strategic Environmental Research and Development Program (SERDP) program for planned combined transition to the Environmental Security Technology Certification Program (ESTCP). - Initiate efforts on ballast tank and system design optimization that minimize fuel discharges from compensated systems, minimize sedimentation in clean ballast and compensated ballast tanks, and maximize exchange of organisms during ballast tank exchanges. - Initiate efforts on solids separation/removal from shipboard liquid waste streams.					
HUMAN SYSTEMS INTEGRATION		2.912	2.362	2.681	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
This activity supports the warfighter by designing affordable user-centered systems that are efficient, easy to use, and provide required mission capabilities at lowest lifecycle costs. Such systems will be optimally designed for the right number and types of personnel, requiring minimum training while providing high skills retention. FY 2008 reflects a reinitiation of work in this field of research, which is paramount to the reduction in complex naval systems design, acquisition, operation, and maintenance costs and improvements in the effectiveness of operations. This effort was funded from FY 2002 through FY 2005 under this PE within the Manpower and Personnel activity; budget priorities led to the gap in funding in FY 2006 and FY 2007. Congressional, DoD, and Navy policies and instructions require the Navy and Marine Corps to have a comprehensive plan for Human Systems Integration (HSI) in the acquisition process to optimize total system performance, minimize total ownership costs, and ensure the system is built to accommodate the characteristics of the user population that will operate, maintain, and support the systems. *FY 2008 Accomplishments:* - Initiated research to develop automation and human interface technologies to support collaborative decision-making in which multiple unmanned system operators manage groups of vehicles with optimal manning. - Initiated research to develop tactical decision making concepts to integrate spatially disparate displays and reduce the reliance of crew support to achieve superior ship commanding officer and crew decision making. - Initiated HSI tool research, development, and application to engineering efforts to develop robust standardized set of human systems integrated specific modeling and simulation tools to assess the interaction between operators performance by system design by manning levels. *FY 2009 Plans:* - Continue all efforts of FY 2008. *FY 2010 Plans:* - Continue all efforts of FY 2009.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate research into mission performance optimization encompassing task centered design and advanced human performance modeling for achieving the requisite manning, both in numbers and capabilities, for the complex ships and systems of the future fleet. - Initiate research into enhancing the ability to identify and fuse relevant multi-sensor data and then effectively presenting this information to the decision making team in order to gain tactical knowledge and improve their operational performances.					
LITTORAL COMBAT / POWER PROJECTION This activity provides for technologies that enhance the ability of the Navy-Marine Corps team to assure access and sustained operations in the Littorals. The FNC Program considers all the critical functions of warfighting: command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR); fires; strike; maneuver; sustainment; and fleet/force protection. This activity includes technical assessments and trade studies for FNC Enabling Capabilities that transition high priority technologies to the Navy and Marine Corps in support of the Sea Strike, Sea Shield, Sea Basing, and ForceNet Naval Power 21 pillars as well as Enterprise and Platform Enabling Science and Technology requirements. The decrease from FY 2008 to FY 2009 reflects the completion of the Battlefield Power Generation Technology FNC effort in FY 2008. The increase from FY 2009 to FY 2010 is due to the initiation of new FNC efforts to reduce the load of dismounted combatants and to improve SSN/SSGN next generation photonics mast capabilities. *FY 2008 Accomplishments:* - Completed development of battlefield power generation technologies. - Initiated efforts to conduct FNC warfighter sustainment applied research, including technology management of FNC investments supporting the naval enterprise and naval capability pillars.		8.047	6.271	14.632	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated efforts to perform technology analyses to support the development and validation of FNC technology performance metrics for enabling capabilities structured to close naval capability gaps. - Initiated efforts to assess technology options for the development of applied FNC technologies packaged into deliverable S&T products. *FY 2009 Plans:* - Continue all efforts of FY 2008 less those noted as completed above. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Initiate development of technologies to reduce the load of warfighters by 1) reducing the weight of and improving the capability of the day/night weapon sight, 2) eliminating battery incompatibility, and 3) providing GUI-based software for tradeoff analyses based on Military Operational Posture. (Concurrent funding provided by PE 0603236N) - Initiate research to develop technology to reduce fabrication and life cycle costs of SSN/SSGN next generation photonics mast and to improve SSN surface situational awareness through faster image acquisition rates, improve range performance under adverse weather conditions and improve autonomous detection and classification. (Concurrent funding provided by PE 0603236N) - Initiate efforts to assess technology options for the development of applied FNC technologies packaged into deliverable S&T products.					
MANPOWER/PERSONNEL These technologies enhance the Navy's ability to select, assign, and manage its people by responding to a variety of requirements, including: managing the force efficiently and maintaining readiness with fewer people and smaller budgets; providing warfighting capabilities optimized for low-intensity conflict and littoral warfare; and operating and maintaining increasingly sophisticated weapons systems while managing individual workload and supporting optimal manning. This activity further supports the warfighter by providing enhanced capabilities by designing affordable user-centered systems that are efficient, easy to use, and provide required mission capabilities at lowest		2.999	2.718	2.827	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
lifecycle costs. Such systems will be optimally designed for the right number and types of personnel, requiring minimum training while providing high skills retention. *FY 2008 Accomplishments:* - Continued low-velocity impact and shaker table dynamic internal response mapping with new anatomical features and sensor suite GelMan thoracic surrogate. - Initiated development of a virtual, experimental-based software environment to test and evaluate the effect of various incentive structures on resource allocation decision making. - Initiated development of artificial intelligence and optimization techniques to create simulation based decision support tools for resource allocations across units and battle groups. - Initiated development of Unit-level tools to enable commanders to analyze the cost implications of their actions and weigh tradeoffs between readiness, cost, and risk. - Initiated development of intelligent agents to empower total force members to make training and assignment choices that enhance their careers and meet personal goals. - Initiated research to provide results for guiding the development on an interface allowing experts in HSI to work with subject matter experts to define and refine critical intra-domain concepts while capturing information for future use. - Initiated a continuous engineering process evaluation and adaptation to show that the developing process is executable and effective. *FY 2009 Plans:* - Continue all efforts of FY 2008. - Complete low-velocity impact and shaker table dynamic internal response mapping with new anatomical features and sensor suite GelMan thoracic surrogate. *FY 2010 Plans:* - Continue all efforts of FY 2009.					
MEDICAL TECHNOLOGIES		14.821	12.134	18.378	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
This program supports the development 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. The National Institutes of Health (NIH) focuses on the basic science of disease processes and not applied research related to development. Programs are coordinated with other Services through the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee, and Joint Technical Coordinating Group (JTCG) process, to prevent duplication of effort. This project funds the Force Health Protection FNC that will provide technology options for future Navy and Marine Corps capabilities 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". The decrease from FY 2008 to FY 2009 is due to the completion of several traumatic brain injury (TBI) efforts and a transition of investments to advanced technology. The increase from FY 2009 to FY 2010 reflects the initiation of Naval Noise-Induced Hearing Loss (NIHL) efforts to reduce the incidence of NIHL. *FY 2008 Accomplishments:* - Continued studies on decompression sickness (DCS) and arterial gas embolism (AGE), to include novel approaches to the prevention, detection and treatment of DCS/AGE, 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 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. - Continued studies related to optimization of diver performance. Operational performance in the undersea environment can be hampered by a variety of environmental stressors.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued studies related to optimization of submariner health and performance. Submarine crewmembers are exposed to a variety of unique stressors including prolonged deployments, effects of altered diurnal rhythms, non-standard breathing gases, lack of sunlight, etc that can impact health and performance. - Continued studies related to biomedical effects of underwater sound. Military divers must operate safely and effectively in potentially complex underwater sound fields. - Continued efforts for “stress inoculation” to mitigate the impact of exposure to stressful combat environments prior to deployment. - Completed study to evaluate endomorphin-based product to treat traumatic brain injury (TBI). - Completed research to treat and prevent attrition due to combat related psychological stress and acute Post Traumatic Stress Disorder (PTSD), a significant problem for retention of personnel. - Initiated program to develop enhanced First Responder capabilities. - Initiated program to develop enhanced Forward Resuscitative Surgical capabilities. - Initiated program to develop enhanced En Route Care capabilities. - Initiated efforts to mitigate the effects of environmental and other threats to health. - Initiated program, with Army, in regenerative medicine (Armed Forces Institute for Regenerative Medicine (AFIRM)). - Initiated efforts to reduce operational injuries. - Initiated efforts to reverse NIHL. *FY 2009 Plans:* - Continue all efforts of FY 2008 less those noted as completed above. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Initiate research to reduce noise at the source, i.e. jet engine quieting and flight deck noise reduction. - Initiate research to study the incidence and susceptibility of Noise Induced Hearing Loss (NIHL) and tinnitus, and to evaluate mitigation strategies. - Initiate research in medical prevention and treatment of NIHL and tinnitus (ringing in the ears). - Initiate research to improve personal protective equipment technology.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate research to develop a Human Injury and Treatment (HIT) model for predicting outcomes of personnel exposure to shipboard damage. - Initiate and develop mature force health protection technologies that support naval requirements identified within the Navy and Marine Corps.					
SEA BASING TECHNOLOGIES		14.529	28.001	23.327	
This activity includes development and advancement of technologies to support Seabasing. 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. The increase from FY 2008 to FY 2009 represents changes in the complexity and cost for expanded efforts under the Sea Base to “Over-the-Shore” Connector Prototype (T-CRAFT Innovative Naval Prototype (INP) program model design and fabrication). This change is also due to continuation of the Sense and Respond Logistics(S&RL) program, and movement of Automated-semi-automated Weapons Breakout and Build-up System funding from Cost Reduction Technologies into this R-2 Activity where the effort is correctly identified in the FY 2008 Plans. The decrease in funding from FY 2009 to FY 2010 is due to the beginning of technical evaluation and down-selection for the T-CRAFT as well as the beginning of prototype and component development for the T-Craft. *FY 2008 Accomplishments:* - Continued multiple INP contracts for preliminary designs in the area of a T-CRAFT and a Rapidly Deployable Seabasing Stable Transfer Platform. - Continued the down-selection of T-CRAFT designs for further development and model construction and testing. - Continued T-CRAFT model construction and testing. - Continued the construction of a scaled model of a Rapidly Deployable Stable Transfer Platform demonstrator. - Continued a second evaluation of potential Seabasing INP efforts.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated planning of T-CRAFT prototype and component development. - Initiated Sense and Respond Logistics (S&RL) research in: battlefield fuel management; decision support systems for S&RL; emergent intelligence/intelligent agents for S&RL; and advanced sensors/ processes for S&RL. *FY 2009 Plans:* - Continue all efforts of FY 2008 and expand efforts under the Sea Base to “Over-the-Shore” Connector Prototype (T-CRAFT Innovative Naval Prototype (INP) program model design and fabrication). - Continue efforts for the development of technologies supporting automated shipboard assembly of air-delivered weapons. (Transitions from Cost Reduction Technologies activity in this PE in FY 2009.) - Initiate the down-selection of Sense and Respond Logistics Information Architecture prototype development. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete the down-selection of T-CRAFT designs for prototype and component development. - Complete T-CRAFT model testing and evaluation. - Initiate contract design and develop shipyard building plans for T-CRAFT prototype and component construction. - Initiate procurement of components and material to support T-CRAFT prototype construction. - Initiate development of agent based decision support and logistics planning algorithms.					
TRAINING TECHNOLOGIES Training technologies enhance the Navy's ability to train effectively and affordably in classroom settings, in simulated environments, while deployed, and to operate effectively in the complex, high-stress, information-rich and ambiguous environments of modern warfare such as asymmetric warfare. Technology development responds to a variety of requirements, including providing more affordable approaches to training and skill maintenance. Improved training efficiency and cost-effectiveness is		9.790	10.699	10.328	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
achieved by applying operations research, modeling and simulation, and instructional, cognitive, and computer sciences to the development, delivery, evaluation, and execution of training. *FY 2008 Accomplishments:* - Continued program on intelligent agents for objective-based training. - Continued Computer Generated Forces (CGF) task aimed at improved techniques for human cognitive and behavioral modeling. - Continued work on effective feedback in artificially intelligent tutoring for dynamic task environments such as anti-air warfare, instrument flying and other characteristic military tasks. - Continued a systematic program of applied research addressing unanswered questions regarding effective instructional strategies in artificially intelligent tutoring. - Continued work on software tools to facilitate building natural language tutorial dialogs for artificially intelligent tutoring. - Continued 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. - Continued 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. - Continued field studies and user tests evaluating new features and job aiding tools. - Initiated development of optimized strategies for performance aiding and training. - Initiated development of virtual technologies for warfare training application. - Initiated development of technologies to support human performance in networked warfighting environments. - Initiated development of training technologies for culture, values, and language training and opponent simulation for training systems. *FY 2009 Plans:* - Continue all efforts of FY 2008.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate research to create computational models of human behavior in selected non-Western environments that reflect the dominant cultural, social, ethnic, and economic determinants of behaviors, attitudes, and beliefs of individuals, groups, and organizations operating in these environments, and exploit these models to forecast responses to our actions and those of others attempting to exert influence in these environments. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Initiate research into computational neuron-models in the design of training systems - Initiate the integration of cognitive and neuron-computational models of human learning. - Initiate research into intelligent tutoring systems for adaptive competency in submarine bridge team and surface ship combat information center trainers.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH	PROJECT NUMBER 0000

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0308601N/Modeling and Simulation Support									Continuing	Continuing
PE 0601102A/Defense Research Sciences									Continuing	Continuing
PE 0601102F/Defense Research Sciences									Continuing	Continuing
PE 0601103N/University Research Initiatives									Continuing	Continuing
PE 0601152N/In-House Laboratory Independent Research									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602102F/Materials									Continuing	Continuing
PE 0602105A/Materials Technology									Continuing	Continuing
PE 0602123N/Force Protection Applied Research									Continuing	Continuing
PE 0602202F/Human Effectiveness Applied Research									Continuing	Continuing
PE 0602203F/Aerospace Propulsion									Continuing	Continuing
PE 0602204F/Aerospace Sensors									Continuing	Continuing
PE 0602211A/Aviation Technology									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH	PROJECT NUMBER 0000	
PE 0602303A/Missile Technology		Continuing	Continuing
PE 0602435N/Ocean Warfighting Environment Applied Research		Continuing	Continuing
PE 0602601A/Combat Vehicle and Automotive Technology		Continuing	Continuing
PE 0602702F/ Command Control and Communications		Continuing	Continuing
PE 0602705A/Electronics and Electronic Devices		Continuing	Continuing
PE 0602709A/Night Vision Technology		Continuing	Continuing
PE 0602716A/Human Factors Engineering Technology		Continuing	Continuing
PE 0602747N/Undersea Warfare Applied Research		Continuing	Continuing
PE 0602785A/Manpower/ Personnel/Training Technology		Continuing	Continuing
PE 0602786A/Warfighter Technology		Continuing	Continuing
PE 0602787A/Medical Technology		Continuing	Continuing
PE 0603002A/Medical Advanced Technology		Continuing	Continuing
PE 0603003A/Aviation Advanced Technology		Continuing	Continuing
		Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH	PROJECT NUMBER 0000	
PE 0603216F/Aerospace Propulsion and Power Technology			
PE 0603236N/Warfighter Sustainment Advanced Technology		Continuing	Continuing
PE 0603512N/Carrier Systems Development		Continuing	Continuing
PE 0603640M/USMC Advanced Technology Demonstration (ATD)		Continuing	Continuing
PE 0603716D8Z/Strategic Environmental Research Program		Continuing	Continuing
PE 0603721N/ Environmental Protection		Continuing	Continuing
PE 0603724N/Navy Energy Program		Continuing	Continuing
PE 0603729N/Warfighter Protection Advanced Technology		Continuing	Continuing
PE 0603851D8Z/ Environmental Security Technical Certification Program		Continuing	Continuing
PE 0604561N/SSN-21 Developments		Continuing	Continuing
PE 0604703N/Personnel, Training, Simulation, and Human Factors		Continuing	Continuing
PE 0604771N/Medical Development		Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602236N WARFIGHTER SUSTAINMENT APPLIED RESEARCH	PROJECT NUMBER 0000

PE 0605152N/Studies and Analysis Support - Navy	Continuing	Continuing
PE 0708011N/Industrial Preparedness	Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

As discussed in Section A, there are a significant number of varied efforts within this PE. For the most part these efforts support the FNC program. As such, each is monitored at two levels. At the lowest level each is measured against both technical and financial milestones on a monthly basis. Annually each FNC and its projects are reviewed in depth for technical and transition performance by the Chief of Naval Research against goals which have been approved by the Navy.

The FNC managers conduct routine site visits to performing organizations to assess programmatic and technical progress and most projects conduct an annual or bi-annual review by an independent board of visitors who assess the level and quality of the Science and Technology (S&T) basis for the project.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	60.187	59.668	64.816						Continuing	Continuing
0000: ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	60.187	59.668	64.816						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

The Electromagnetic Systems Applied Research Program addresses technology needs associated with Naval platforms for new capabilities in EO/IR Sensors, Surveillance, Electronic Warfare, Navigation, Solid State Electronics, Vacuum Electronics Power Amplifiers, and Nanoelectronics. The program supports development of technologies to enable capabilities in Missile Defense, Directed Energy, Platform Protection, Time Critical Strike, and Information Distribution. This program directly supports the Department of Defense Joint Warfighter Plan and the Defense Technology Area Plans. Activities and efforts within this Program have attributes that focus on enhancing the affordability of warfighting systems. The program also provides for technology efforts to maintain proactive connectivity and collaboration between Department of the Navy (DON) Science and Technology (S&T) and Joint, Navy, and Marine Corps commands worldwide.

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

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	**R-1 ITEM NOMENCLATURE** PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	52.529	54.830	49.764	
Current BES/President's Budget	60.187	59.668	64.816	
Total Adjustments	7.658	4.838	15.052	
Congressional Program Reductions		-0.188		
Congressional Rescissions				
Total Congressional Increases		5.040		
Total Reprogrammings	8.079			
SBIR/STTR Transfer	-0.421			
Program Adjustments			14.970	
Rate/Misc Adjustments		-0.014	0.082	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **ENERGY EFFICIENT GALLIUM NITRIDE SEMICONDUCTOR TECHNOLOGY**	0.000	1.037
Project: 9999, **GALLIUM NITRIDE RF POWER TECHNOLOGY**	1.930	1.596
Project: 9999, **MICROWAVE FERRITES AND MULTIFUNCTIONAL INTEGRATED CIRCUITS**	0.771	0.000
Project: 9999, **NATIONAL INITIATIVES FOR APPLICATIONS OF MULTIFUNCTIONAL MATERIALS**	1.543	1.595
Project: 9999, **NOTRE DAME CENTER FOR THE ENGINEERING OF OXIDE NITRIDE STRUCTURES (CEONS)**	1.543	0.000
Project: 9999, **REPARATIVE CORE MEDICINE**	0.965	0.798
Project: 9999, **ULTRA STABLE COHERENT LASER**	0.773	0.000

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH					PROJECT NUMBER 0000	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
0000: ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	60.187	59.668	64.816						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project addresses technology opportunities associated with Naval platforms for new capabilities in EO/IR Sensors, Surveillance, Electronic Warfare, Navigation, Solid State Electronics, Vacuum Electronics Power Amplifiers, and Nanoelectronics. The project supports development of technologies to enable capabilities in Missile Defense, Directed Energy, Platform Protection, Time Critical Strike, and Information Distribution. This project directly supports the Department of Defense Joint Warfighter Plan and the Defense Technology Area Plans. Activities and efforts within this program have attributes that focus on enhancing the affordability of warfighting systems. The program also provides for technology efforts to maintain proactive connectivity and collaboration between Department of the Navy (DON) Science and Technology (S&T) and Joint, Navy, and Marine Corps commands worldwide.

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

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
ELECTRONIC AND ELECTROMAGNETIC SYSTEMS (FORMERLY ELECTRONICS AND COMMUNICATIONS TECHNOLOGIES)	15.525	14.210	17.670	
This R2 activity is devoted to mid-term technology development in close concert with programs of record. The products of these efforts are expected to transition at the end of their schedule into the associated program of record. These Future Naval Capability (FNC) Enabling Capabilities (EC's) span across the Electronics, EW, Radar, Communications, and other technology areas supporting Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR). This R2 activity also appears in PE 0603271N. For Enabling Capabilities (EC) receiving funding from both PE's the PE 0602271N portion is generally focused on component design and development while the funding from PE 0603271N is focused on integration and demonstration. The specific objectives of the current EC's are:				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
a) Next Generation Airborne Electronic Attack: Develop and demonstrate advanced capability Airborne Electronic Attack (AEA) sub-systems (e.g., broadband exciters, power amplifiers, and transmit arrays) that provide Suppression of Enemy Air Defenses (SEAD), deliver Non-Kinetic Fires, counter Integrated Air Defense Systems (IADS), and provide suppression of Command, Control & Communications (C3) links and data networks. b) Countermeasures Technologies for Anti-Ship Cruise Missiles (ASCM) and Anti-Ship Ballistic Missiles (ASBM) Defense: Improve ship survivability by disrupting the terminal engagement phase of hostile anti-ship cruise and ballistic missiles, including improvements to both onboard (Enhanced Surface Electronic Warfare Improvement Program,(SEWIP)) and offboard (Nulka) radio frequency (RF) Electronic Attack systems. c) Next Generation Countermeasure Technologies for Ship Missile Defense: Develop and demonstrate the fundamental technologies required to conduct next generation, persistent Electronic Warfare (EW) in support of ship, sea base, and littoral force missile defense operations in a distributed, coordinated manner across the entire battlespace. d) Long Range Detection and Tracking: Develop capability for simultaneous full volume radar coverage of contacts at long ranges and in a dense contact environment. e) Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms: Develop and demonstrate electronics components technologies using wide bandgap semiconductors, mixed signal analog and digital, RF, microwave, millimeter wave and associated passive components thus enabling high efficiency transmitter element chains for arrays. f) Affordable Common Radar Architecture: Develop a common affordable, scalable, open radar architecture that provides affordable capability improvements and addresses total ownership cost challenges for 5 different radars.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
g) Low Cost over the Horizon Communications, Satellite Communications (SATCOM) and Line of Sight (LOS) Apertures: Develop technologies that provide the tools to implement a wideband tactical communications infrastructure. Developments will include techniques for LOS relay and routing using airborne platforms, as well as a SATCOM on-the-move capability for United States Marine Corps (USMC) tactical ground vehicles. Also included are technologies for pointing and tracking of airborne platforms, open architecture cognitive radio technologies, communications security (COMSEC), networking, and airborne apertures necessary for airborne relay and routing. Further developments include techniques for integrating multiple shipboard apertures in a limited space, cosite mitigation and the investigation of digital radio technologies that permit digitization at the aperture itself. h) SATCOM Vulnerability Mitigation: Develop technologies for mitigating SATCOM vulnerabilities using a wideband surface and airborne infrastructure. Technologies include approaches for development of ultra-low cost phased arrays and techniques for mitigating multi-path and scintillation on communications links. Architecture and application development will include surface-to-air and surface-to-surface communications in the 14-17 gigahertz (GHz) band, and air-to-air communications in the millimeter wave bands. Additionally, advanced techniques for the use of the high frequency (HF) and ultra high frequency (UHF) spectrum will be developed which include beam forming techniques and alternative waveform designs that increase throughput by a factor of four times (4X) by adapting to spectrum and operating conditions. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. The increase from FY 2009 to FY 2010 is associated with initiation of new FNC efforts in the Countermeasure Technologies for Anti-Ship Missile Defense Enabling Capabilities program. *FY 2008 Accomplishments:* Next Generation Airborne Electronic Attack: - Continued the development of RF technologies that support advances in receiver architecture, antenna performance, subsystem miniaturization, decoys and advanced signal processing.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated the Next Generation Airborne Electronic Attack (NGAEA) effort by conducting a requirements validation and technology assessment review. Countermeasures Technologies for Anti-Ship Cruise Missiles (ASCM) and Anti-Ship Ballistic Missile (ASBM) Defense: - Continued establishment of an industrial standard appropriate for the demonstration of greater than 106(>1E6) hour lifetime for RF life testing of Gallium Nitride (GaN) based Millimeter-Wave Integrated Circuits (MMICs) and devices, and began to apply this standard to state-of-the-art (SOA) MMICs and devices. - Completed component chain optimization for Advanced Multifunctional Radio Frequency Concept (AMRFC) Multifunction Electronic Warfare (MFEW) transmitter technology with a target of meeting FY 2011 transition target date. - Initiated the Enhanced Nulka Payload FNC effort by conducting a Transmitter and Receiver Technology Trade Space study. - Initiated the Enhanced Surface Electronic Warfare Improvement Program (SEWIP) Transmitter FNC effort by conducting a Transmitter and Cooling Technology Trade Space study. Long Range Detection and Tracking: - Continued demonstration of packaging techniques to provide cost reduction and affordability for modules, including component architecture, packaging, and scale of integration optimization. - Initiated design and development of a X-Band Digital Array Radar (DAR). - Initiated development of Maritime Classification and Identification modes for APY-6. Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms: - Completed highly integrated and affordable receiver (RX) component optimization supporting multifunction electronics and array technologies. This includes the optimization of entire component chains of Low Noise Amplifiers (LNAs), Analog-to-Digital Converters (ADCs), tunable filters, channelizers, radiating elements specific to the MFEW receiver, and two-dimensional (2D) electronically scanned arrays for a reduced cost to 1/3 of current multi-function RF systems for a minimum of 6-18 GHz bandwidth. (e)				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated effort on Affordable Electronically Scanned Array Technology to include electronics component technologies supporting S-band radar, X-band radar and electronic attack. Low Cost over the Horizon Communication, Satellite Communications (SATCOM) and Line of Sight (LOS) Apertures: - Initiated development of technology to provide a set of apertures (Line of Sight, Satellite Communications) and link electronics that are suitable for broad Naval applications. - Initiated development of technology to provide open, programmable core terminal components applicable to multiple platforms to include airborne applications and Marine vehicles. *FY 2009 Plans:* Next Generation Airborne Electronic Attack: - Continue all efforts of FY 2008. Countermeasures Technologies for Anti-Ship Cruise Missiles (ASCM) and Anti-Ship Ballistic Missile (ASBM) Defense: - Continue all efforts of FY 2008 less those noted as completed above. Long Range Detection and Tracking: - Continue all efforts of FY 2008. Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms: - Continue all efforts of FY 2008 less those noted as completed above. Low Cost over the Horizon Communication, Satellite Communications (SATCOM) and Line of Sight (LOS) Apertures: - Continue all efforts of FY 2008. *FY 2010 Plans:* Next Generation Airborne Electronic Attack:				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

- Continue all efforts of FY 2009.

Countermeasures Technologies for Anti-Ship Cruise Missiles (ASCM) and Anti-Ship Ballistic Missile (ASBM) Defense:
- Continue all efforts of FY 2009.

Next Generation Countermeasure Technologies for Ship Missile Defense:
- Initiate the Next Generation Countermeasures Technologies for Ship Missile Defense effort by development of techniques and technology for coordination of offboard surface/air EW payloads to achieve wide area protection for defense against anti-ship missiles.

Long Range Detection and Tracking:
- Continue all efforts of FY 2009.
- Complete development of full volume surveillance capability of the DAR advanced development model prototype.

Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms:
- Continue all efforts of FY 2009.

Affordable Common Radar Architecture (ACRA):
- Initiate development of an Affordable Common Radar Architecture to improve supportability and performance of multiple legacy radars.

Low Cost over the Horizon Communication, Satellite Communications (SATCOM) and Line of Sight (LOS) Apertures:
- Continue all efforts of FY 2009.

SATCOM Vulnerability Mitigation:
- Initiate development of advanced techniques for the use of the HF and UHF spectrum, including beam forming and alternative waveforms.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate demonstration of technology components (apertures, cosite mitigation techniques, advanced programmable radios) needed to support Low Cost over the Horizon Communication, SATCOM and LOS links.					
ELECTRONIC WARFARE TECHNOLOGY (FORMERLY RF ELECTRONIC WARFARE TECHNOLOGY) The overarching objective of this activity is to develop technologies that enable the development of affordable, effective and robust Electronic Warfare (EW) systems across the entire electromagnetic spectrum that will increase the operational effectiveness and survivability of U.S. Naval units. Emphasis is placed on passive sensors and active and passive countermeasure (CM) 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 against 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. This activity also includes developments to protect these technologies from external interference and modeling and simulation required to support the development of these technologies. The current specific objectives are: a) Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest: Develop sensors for the purpose of detection, localization, and identification of hostile signals of interest anywhere in the electromagnetic spectrum to provide autonomous and persistent Intelligence, Surveillance, and Reconnaissance (ISR) to forward deployed forces and detecting/identifying terrorists/ hostiles and their communications networks. b) Components and Advanced Architectures/Signal Processing Designs: Develop components and advanced architectures/signal processing designs to ensure effective and reliable threat detection of hostile emissions in dense environments. c) Countermeasures and Techniques to Defeat Advanced Radio Frequency (RF) Guided Threats: Develop countermeasures and techniques to defeat advanced radio frequency (RF) guided threats to protect high value assets from advanced weapon attack, develop forward deployed jamming systems to		9.239	16.376	16.574	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

negate advanced RF surveillance systems, and deny enemy usage of Global Positioning System (GPS) navigation.

d) Countermeasures and Techniques to Defeat Advanced Electro-Optic/Infrared (EO/IR) Guided Threats: Develop countermeasures and techniques to defeat advanced EO/IR guided threats to protect high value assets from advanced weapon attack, disrupt and attack EO/IR ISR assets, and provide false/misleading information to hostile EO/IR targeting and tracking systems.

e) Modeling and Simulation: Use modeling and simulation to assess the effectiveness of Electronic Attack (EA) engagements to develop an understanding of adversary threat characteristics to support countermeasures technique requirements/development and assess/predict engagement effectiveness to optimize combat system engagement resources.

f) Electronic Protection from Electromagnetic Interference (EMI) and Electronic Attack (EA): Develop Electronic Protection (EP)/Electronic Counter-Countermeasures (ECCM) to prevent the disruption and denial of U.S. Naval RF and EO/IR sensors and systems from both unintentional EMI and intentional EA and permit unimpeded usage of the electromagnetic spectrum by U.S. and allied forces.

The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.

The increase from FY 2008 to FY 2009 is due to initiation of the following efforts: Antennas from VHF to THz, Cueing Receiver for Faster EA Response Management, the Digital Directional Correlator, and research for development of power amplifiers for future RF systems.

FY 2008 Accomplishments:

Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest:
- Continued technology development in the areas of Tactical Aircraft, Surface Ships, Submarines, Unmanned Aerial Vehicles (UAVs), and EW Enabling Technology.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Completed the Countermeasures to Anti-Helicopter Mines (AHM) effort by conducting a field test of the system against AHM or simulators. - Initiated the development of techniques to identify and exploit the processing vulnerability of passive location systems. Components and Advanced Architectures/Signal Processing Designs: - Continued development of RF technologies that support advances in receiver architecture, antenna performance, subsystem miniaturization, decoys and advanced signal processing. - Completed the development of an integrated Digital EW, EA and Electronic Support (ES) suite using a tightly coupled common architecture so that there is a synergistic coupling between the sub-functions of ES and EA.) - Completed the Ka/W Band Miniature Sensor Development effort by testing and delivering a prototype sensor system. - Initiated the development of a novel approach to near real time active digital augmentation to improve the isolation of shipboard EW systems. Countermeasures and Techniques to Defeat Advanced Radio Frequency (RF) Guided Threats: - Continued the investigation of Millimeter Wave (MMW) technologies to support the development of off board and onboard countermeasures. - Continued the design and development of a miniature coherent transponder to counter modern threats using advanced electronic protection techniques. - Continued the development of a series of kinetically driven devices to generate RF. - Completed the Compact Electro-Magnetic (EM) Source for Improvised Explosive Device (IED) and Engine Defeat effort by conducting a field test of an advanced source. - Initiated the development to assess the electronic protection capability of modern missiles using advanced processing and investigated the improvements needed to restore countermeasures effectiveness. Countermeasures and Techniques to Defeat Advanced Electro-Optic/Infrared (EO/IR) Guided Threats:				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Completed the development of analysis/modeling infrastructure and prototype improvement concepts for electronic countermeasures and counter-targeting against RF surveillance threats. - Completed the development and demonstration of a compact EA technology for tactical unmanned vehicle systems to counter wideband, spread spectrum active electronically steered array radars. Modeling and Simulation: - Continued the EW Tactical Decision Algorithm (TDA) for Satellite Communications effort by evaluating two atmospheric propagation models to assist in visualizing the impact of satellite communications on future planning and tactics. *FY 2009 Plans:* Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest: - Continue all efforts of FY 2008 less those noted as completed above. - Initiate the Digital Directional Correlator effort by building and refining a more complete simulation of the correlator and determining via simulation and analysis the primary characteristics required for the system. Components and Advanced Architectures/Signal Processing Designs: - Continue all efforts of FY 2008 less those noted as completed above. - Initiate the Miniature 2-70 GHz Integrated Optical Channelizer effort by starting Phase I and specifications development. - Initiate the Cueing Receiver for Faster EA Response Management effort by beginning system design. - Initiate the Antennas from VHF to THz effort through development of the log-periodic antenna. - Initiate the Exploiting Non-Traditional Signals Using a Photonics Based Signal Processor effort by performing proof-of-concept demonstrations for the three main modes of operation for the spatial spectral optical materials when used for Electronics Support Measures (ESM) applications. Countermeasures and Techniques to Defeat Advanced Radio Frequency (RF) Guided Threats: - Continue all efforts of FY 2008 less those noted as completed above. - Complete the design and development of a miniature coherent transponder to counter modern threats using advanced electronic protection techniques.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

- Complete the development of a series of kinetically driven devices to generate RF.
- Initiate research for development of power amplifiers for future RF systems.

Modeling and Simulation:
- Continue all efforts of FY 2008.

FY 2010 Plans:

Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest:
- Continue all efforts of FY 2009.
- Continue the development of techniques to identify and exploit the processing vulnerability of passive location systems. Transferred from PE 0602271N Supporting Technologies.
- Complete the Digital Directional Correlator (DDC) effort capable of detecting, identifying, and measuring the directional azimuth and elevation of all RF emitters (including frequency hoppers) within a 360 degree field of view in a single circular sweep.

Components and Advanced Architectures/Signal Processing Designs:
- Continue all efforts of FY 2009.
- Complete the Miniature 2-70 GHz Integrated Optical Channelizer (IOC) effort by fabricating and demonstrating the second generation IOC.
- Complete the Exploiting Non-Traditional Signals Using a Photonics Based Signal Processor effort that will rapidly and accurately detect and identify non-traditional RF signals including spread spectrum, frequency hopping, noise-like waveforms, and unintentional RF emissions.
- Complete the Cueing Receiver for Faster EA Response Management effort by integrating the receiver into the Naval Post Graduate School's photonic, single-bit 1st order sigma-delta digital antenna to test and evaluate the new architecture's ability to digitize wideband signals directly at the antenna.
- Complete the Antennas from VHF to THz effort by testing the final combo antenna from 0.03-110 GHz.
- Initiate the Direction Finding of Low Probability of Intercept (LPI) Emitters effort by commencing digital algorithm development.

Countermeasures and Techniques to Defeat Advanced Radio Frequency (RF) Guided Threats:

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continue all efforts of FY 2009 less those noted as completed above. - Complete the development to assess the electronic protection capability of modern missiles using advanced processing and investigate the improvements needed to restore countermeasures effectiveness. Transferred from PE 0602271N Supporting Technologies. - Initiate the Concurrent Multi-Spectral RF Carrier Generator effort to develop a single-chip, low power multi-spectral RF jamming sub-system that has programmable and automatic random mode switching and nanosecond frequency hopping over 1-18 GHz. Countermeasures and Techniques to Defeat Advanced Electro-Optic/Infrared (EO/IR) Guided Threats: - Initiate efforts to Detect and Deny EO/IR ISR Systems by developing passive and active detection systems using advanced Focal Plane Array (FPA)-based sensors and multi-spectral laser transmitters. - Initiate efforts to Detect and Defeat Imaging IR sensors by developing laser-based countermeasures and advanced IR expendable decoys. Modeling and Simulation: - Continue all efforts of FY 2009. - Complete the EW Tactical Decision Algorithms (TDA) for Satellite Communications effort by evaluating two atmospheric propagation models to assist in visualizing the impact of satellite communications on future planning and tactics. - Initiate the Real-Time EA Effectiveness Monitoring effort to assess the effectiveness in real-time of jamming an RF guided missile by exploiting the missile's RF transmission characteristics. - Initiate the Integrated Onboard/Offboard EA Effectiveness effort by starting investigation with off-board decoy waveforms and structured ship targets. Electronic Protection from Electromagnetic Interference (EMI) and Electronic Attack (EA): - Initiate efforts for Electronic Protection of RF Sensors by developing passive and active techniques to adaptively process RF signals in EA denied and RF saturation environments. - Initiate efforts for Electronic Protection of EO/IR Sensors by developing passive and active techniques to adaptively filter EO/IR radiation in EA denied and EO/IR saturation environments.					
EO/IR SENSOR TECHNOLOGIES		0.000	0.000	6.869	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
The overarching objective of this thrust is to develop technologies that enable the development of affordable, wide area, persistent surveillance optical architectures, day/night/all weather, adaptable, multi-mission sensor technology comprised of optical sources, detectors, and signal processing components for search, detect, track ,classify, identify (ID), intent determination, and targeting applications and includes developments to protect these technologies from external interference. Also included are modeling and simulation required to support the development of these technologies. Efforts will also include the development of optical RF components, infrared technologies including lasers and focal plane arrays using narrow bandgap semiconductors. The current specific objectives are: a) Optically Based Terahertz (THz) and Millimeter Wave Distributed Aperture Systems: Develop optically based terahertz (THz) and millimeter wave distributed aperture systems for imaging through clouds, fog, haze and dust on air platforms. b) Wide Area Optical Architectures: Develop wide area optical architectures for persistent surveillance for severely size constrained airborne applications. c) High Power Laser Sources: Develop high power laser sources for countermeasure and active imaging applications. d) Dynamic, Adaptable Wide Field-of-View (WFOV)/Narrow Field-of-View (NFOV) Surveillance and Sensor Technology: Develop dynamic, adaptable wide field-of-view (WFOV)/narrow field-of-view (NFOV) surveillance and sensor technology for airborne surveillance, identification, and targeting applications. e) Non-cryogenically Cooled Infrared Photon Detectors: Develop non-cryogenically cooled infrared photon detectors for compact sensors on severely power constrained platforms. f) Unmanned Aerial Vehicle (UAV) Deployable Infrared (IR) Sensor Payloads: Develop unmanned aerial vehicle (UAV) deployable infrared (EO/IR) sensor payloads for persistent surveillance missions.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Efforts in this activity were transferred from the Navigation, Electro Optic/Infrared (EO/IR), and Sensor Technologies activity within PE 0602114N. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. In FY 2010, EO/IR efforts previously detailed in the FY 2009 Electronic Warfare Technology Activity are being consolidated into this new activity to provide improved justification of the nature of the funded research and better alignment with future naval needs. Likewise, related research formerly funded and justified in the Navigation, Electro Optic/Infrared (EO/IR) and Sensor Technologies Activity in PE 0602114N is being consolidated into this PE and R2 Activity beginning in FY 2010. Funding levels associated with the consolidated efforts are consistent with prior year totals. *FY 2010 Plans:* Optically Based Terahertz (THz)and Millimeter Wave Distributed Aperture Systems: - Continue to perform field demonstration and testing of 94 gigahertz (GHz) passive millimeter wave (MMW) imager. Transferred from PE 0602114N. - Continue the development of techniques to combine current EO/IR technology and recent findings on the characteristics of the eye to classify and identify optical devices and individuals in real time at militarily significant ranges. Transferred from PE 0602114N. - Continue the development of a process to detect hostile camouflaged or hidden targets in shadows and diverse backgrounds of militarily challenging environments. Transferred from PE 0602114N. - Complete the development of signal processing techniques to improve situational awareness and autonomous detection of hostile fire events in a dynamic urban clutter environment. Transferred from PE 0602114N. - Complete the development of an active optics system that can survey a wide area and instantly, non-mechanically zoom-in on an area of interest for target tracking/identification. Transferred from PE 0602114N. - Initiate miniaturization and modularization of MMW imaging system components for small platform systems.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Wide Area Optical Architectures: - Continue development of ultra-high-sensitivity detectors suitable for use in focal plane arrays (FPAs) for the Shortwave Infrared (SWIR) spectral band. Transferred from PE 0602114N. - Continue development of mid and long wave IR focal plane arrays using graded-bandgap W-type-II superlattices with much higher detectivity than state-of-the-art Mercury Cadmium Telluride (HgCdTe,MCT) FPAs. Transferred from PE 0602114N. - Complete field and flight testing of foveated zoom imager. Transferred from PE 0602114N - Complete system integration and test of optically agile zoom imager. Transferred from PE 0602114N. - Initiate design of read-out integrated circuits for temporally adaptive focal plane arrays. - Initiate development of spectrally agile visible, near-infrared, short-wave infrared and midwave infrared imaging technology. - Initiate integration of optically and temporally adaptable imaging technologies into sensor for networked persistent surveillance system. High Power Laser Sources: - Complete development of high power fiber lasers in MWIR (2-5 μm) based upon highly nonlinear IR transmitting chalcogenide photonic crystal fibers. Transferred from PE 0602114N.					
NAVIGATION TECHNOLOGY (FORMERLY RF NAVIGATION TECHNOLOGY) The overarching objective of this activity is to develop technologies that enable the development of affordable, effective and robust Position, Navigation and Timing (PNT) capabilities using the Global Positioning System (GPS), non-GPS navigation devices, and atomic clocks. This project will increase the operational effectiveness of U.S. Naval units. Emphasis is placed on GPS Anti-Jam (AJ) Technology; Precision Time and Time Transfer Technology; and Non-GPS Navigation Technology (Inertial aviation system, bathymetry, gravity and magnetic navigation). The focus is on the mitigation of GPS electronic threats, the development of atomic clocks that possess unique long-term stability and precision, and the development of compact, low-cost Inertial Navigation Systems (INS). The current specific objectives are:		3.247	2.954	2.807	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
a) GPS Anti-Jam Antennas and Receivers: Develop anti-jam and anti-spoofer antennas and antenna electronics for Navy platforms for the purpose of providing precision navigation capabilities in the presence of emerging electronic threats. b) Precision Time and Time Transfer Technology: Develop tactical grade atomic clocks that possess unique long-term stability and precision for the purpose of providing GPS-independent precision time, and the capability of transferring precision time via radio frequency links precision time. c) Non-GPS Navigation Technology: Develop inertial/bathymetric/gravity navigation system for the purpose of providing an alternative means of providing precision navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. *FY 2008 Accomplishments:* GPS Anti-Jam Antennas and Receivers: - Continued the development of GPS AJ Antenna Electronics (AE) with low-cost analog processor technique for Direction of Arrival (DOA) estimation and nulling (up to 60dB nulling capability). - Continued the development of Space-Frequency Adaptive Processing (SFAP) for GPS Anti-Spoofer using the existing Code Gated Maximum Likelihood (CGML) receiver. - Continued the Advanced Spoofer Mitigation and Geolocation through Spoofer Tracking project. - Continued the development of GPS Anti-Spoofer Test Facility at NRL. - Continued the installation of GPS simulator at NRL with GAS-1 and other antennas in an anechoic chamber and conduct tests for four GPS AJ systems. - Initiated the GPS Anti-spoofer mitigation by Direction of Arrival (DOA) project. - Initiated the Acquisition Problem in Deeply Integrated GPS Systems project. Precision Time and Time Transfer Technology: - Initiated the Self-Locked Intra-Cavity Alkali Vapor Laser (ICAL) Opto-Atomic Clock project.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated the Precise and Accurate Stamping for Time Transfer Applications (PASTTA) project. Non-GPS Navigation Technology: - Continued the Deeply Integrated Navigation Grade GPS Inertial System project. - Continued the Improved GPS INS Integration using Particle Filter Accelerometer project. - Initiated the Micro Fiber Optical Gyro (MFOG) project. - Initiated the Ship's Passive Inertial Navigation System (SPINS) project. *FY 2009 Plans:* GPS Anti-Jam Antennas and Receivers: - Continue all efforts of FY 2008. - Complete the Advanced Spoofer Mitigation and Geolocation through Spoofer Tracking project. - Complete the development of GPS Anti-Spoofer Test Facility at NRL. - Complete the installation of GPS simulator at NRL with GAS-1 and other antennas in an anechoic chamber and conduct tests for four GPS AJ systems. - Complete the GPS Anti-spoofer mitigation by DOA project. - Complete the Acquisition Problem in Deeply Integrated GPS Systems project. - Initiate the GPS Dual Receiver Hot Start Acquisition (DRHSA) project. - Initiate the GPS Threat Assessment project at NRL. - Initiate the Multi-Frequency Continuously Operating GPS Anomalous Event Monitor (GAEM) project. - Initiate the Precise at-Sea Ship System for Indoor Outdoor Navigation (PASSION). Precision Time and Time Transfer Technology: - Continue all efforts of FY 2008. - Complete the PASTTA project. - Initiate the Evolved Global Navigation Satellite System (GNSS) Signal Monitoring Receiver Element project. Non-GPS Navigation Technology:				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continue all efforts of FY 2008. - Complete the Improved GPS/INS Integration using a Particle Filter Accelerator project. - Initiate the Sonar Aided Inertial Navigation Technology (SAINT) project. - Initiate the Optically Transduced Inertial Navigation System (INS) Sensor Suite (OPTIMUSS). *FY 2010 Plans:* GPS Anti-Jam Antennas and Receivers: - Continue all efforts of FY 2009 less those noted as completed above. Precision Time and Time Transfer Technology: - Continue all efforts of FY 2009 less those noted as completed above. Non-GPS Navigation Technology: - Continue all efforts of FY 2009 less those noted as completed above. - Initiate development of the Three-Axis Resonant Fiber Optic-based Inertial Navigation System with the accuracy of 10 milli(m)-degrees per hour and the angle random walk (ARW) of 10 milli (m)-degrees per root hour. - Initiate development of the SAINT system for littoral application; the SAINT will be applied to the existing Precision Underwater Mapping (PUMA) device.					
SOLID STATE ELECTRONICS The overarching objective of this activity is to develop higher performance components and subsystems for all classes of military radio frequency (RF) systems that are based on solid state physics phenomena and are enabled by improved understanding of these phenomena, new circuit design concepts and devices, and improvements in the properties of electronic materials. An important subclass are the 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, Joint Counter Radio Controlled Improvised Explosive Device Electronic Warfare (JCREW) 3, and smart weapons systems. Another subclass are the analog and high speed, mixed signal components that connect the electromagnetic signal environment into and out of digitally realized, specific function systems.		0.000	0.000	8.186	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
These improved components are based on both silicon (Si) and compound semiconductors (especially the wide bandgap materials and narrow bandgap materials), low and high temperature superconductors, novel nanometer scale structures and materials. Components addressed by this activity emphasize the MMW and submillimeter wave (SMMW) regions with an increasing emphasis on devices capable of operating in the range from 50 gigahertz (GHz) to 10 terahertz (THz), although there are special applications such as JCREW which also require investment in high frequency (HF) through X-band electronics technology. The functionality of the technology developed cannot be obtained through Commercial-Off-the-Shelf (COTS) as a result of the simultaneous requirements placed on power, frequency, linearity, operational and instantaneous bandwidth, weight, and size. Effort will involve understanding the properties of engineered semiconductors as they apply to quantum information science and technology. The current specific objectives are: a) Solid State Transistors and Devices: Develop solid state transistors and devices for high frequency analog and digital operation. b) High Efficiency, Highly Linear Amplifiers: Develop high efficiency, highly linear amplifiers for microwave, millimeter-wave, low-noise, and power applications. c) Superconducting Electronics: Develop components for RF systems utilizing superconducting and other technologies which are designed to deliver software defined, wide band, many simultaneous signal functionality over a wide range of frequencies, in increasingly field-ready packaging and demonstrate the ability of these components to be combined into chains to deliver superior functionality in conventional system contexts, including, but not limited to, satellite communications (SATCOM)), Electronic Warfare (EW), signal intelligence (SIGINT), and communications. d) Control, Reception, and Processing of Signals: Develop electronics technology that provides for the control, reception, and processing of signals. e) Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures: Develop novel nanometer scale (feature size at or below 10nm) logic/memory devices and related circuits and				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
architectures to deliver ultra-low power, light weight and high performance computational capability for autonomous vehicles and individual warfighters. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. In FY 2010, efforts from Supporting Technologies and Solid State Power Amplifiers are being consolidated into this new activity to provide improved fidelity of efforts. *FY 2010 Plans:* Solid State Transistors and Devices: - Continue development of Antimony (Sb)-based diodes and multipliers for the exploitation of the frequency spectrum from 94-1000 GHz. Transferred from PE 0602271N Supporting Technologies. - Continue development of an integrated tunable frequency selective and low noise integrated module. Transferred from PE 0602271N Supporting Technologies. - Continue effort to develop W-band high-power Gallium Nitride (GaN) Metal Insulator Semiconductor (MIS) transistors. Transferred from PE 0602271N Solid State Power Amplifiers. - Continue MMW field plate GaN HEMT development. Transferred from PE 0602271N Solid State Power Amplifiers. High Efficiency, Highly Linear Amplifiers: - Continue development of MMW AlGaN/GaN wide bandgap HEMT. Transferred from PE 0602271N Solid State Power Amplifiers. - Continue development of AlGaN HEMT broadband amplifiers for electronic warfare decoys with increased power and efficiency than achieved with conventional solid state amplifiers. Transferred from PE 0602271N Solid State Power Amplifiers. - Continue high-efficiency microwave GaN HEMT amplifier development. Transferred from PE 0602271N Solid State Power Amplifiers. - Continue work on GaN MMW components at >44 GHz to allow for EHF SATCOM insertion and other MMW applications spanning to 95GHz. Transferred from PE 0602271N Solid State Power Amplifiers.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		FY 2008	FY 2009	FY 2010	FY 2011

- Continue the expansion of scope of the GaN MMW device program. Transferred from PE 0602271N Solid State Power Amplifiers.
- Continue component development in support of multifunctional electronic warfare. Transferred from PE 0602271N Solid State Power Amplifiers.
- Continue transition of GaN high-efficiency microwave HEMT amplifiers to radar and communications applications. Transferred from PE 0602271N Solid State Power Amplifiers.
- Continue development of MMW high efficiency amplifiers for satellite communications and compact high efficiency MMW sources for active denial systems. Transferred from 62271N Solid State Power Amplifiers.
- Continue development of high-efficiency broadband GaN HEMT amplifiers for electronic warfare applications. Transferred from PE 0602271N Solid State Power Amplifiers.
- Continue Sub-MMW GaN Device technology for communications, target identification and high speed data processing. Transferred from PE 0602271N Solid State Power Amplifiers.
- Complete high efficiency S-Band GaN HEMT amplifier development. Transferred from 62271N Solid State Power Amplifiers.

Superconducting Electronics:
- Continue development of a second generation superconducting digital channelizer which includes a 1xk multiplier. Transferred from PE 0602271N Supporting Technologies.
- Continue demonstration of an improved signal processing technique that can be applied to state-of-the-art L, S, X, and Ka-band superconducting bandpass ADCs to realize an improvement in dynamic range of greater than 6dB. Transferred from PE 0602271N Supporting Technologies.
- Complete proof of concept demonstration of a wideband, high dynamic range combined LNA and antenna, based on arrays of superonducting quantum interference devices (SQUIDs) on a 1 centimeter squared (cm2) chip for frequencies below 200 megahertz (MHz). Transferred from PE 0602271N Supporting Technologies.

Control, Reception, and Processing of Signals:
- Continue development of an integrated tunable frequency selective and low noise integrated module.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures: - Complete development of Cellular Nonlinear Network (CNN) processing techniques for unmanned air vehicle (UAV)landing applications. Transferred from PE 0602271N Supporting Technologies. - Continue effort to develop a highly linear, low-noise RF amplifier using aligned arrays of single-walled carbon nanotubes. Transferred from PE 0602271N Supporting Technologies. - Continue development of three dimensional (3D)-integrated CNN image sensing processing architecture research. Transferred from PE 0602271N Supporting Technologies.					
SOLID STATE POWER AMPLIFIERS (FORMERLY RF SOLID STATE POWER AMPLIFIERS) This activity provides for the generation of High Frequency (HF), Very High Frequency (VHF), Ultra High Frequency (UHF), Micro Wave (MW), and Millimeter Wave (MMW) power amplifiers for Navy all-weather radar, surveillance, reconnaissance, electronic attack, communications, JCREW 3, 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. The current specific objective is: Develop high efficiency, highly linear amplifiers for microwave, millimeter-wave, low-noise, and power applications. The funds increase from FY 2008 to FY 2009 is due to a realignment of funds in FY 2008 from this activity to support higher priority requirements in the Surveillance Technology activity. All FY 2010 efforts in this activity have been transferred to the newly created Solid State Electronics activity to provide for better alignment between future naval needs and the solid state research being conducted. *FY 2008 Accomplishments:* High Efficiency, Highly Linear Amplifiers for Microwave, Millimeter-Wave, Low-Noise, and Power Applications:		3.573	4.322	0.000	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued development of MMW Aluminum Gallium Nitride/Gallium Nitride (AlGaN/GaN) wide bandgap High Electron Mobility Transistor (HEMT). - Continued development of AlGaN HEMT broadband amplifiers for electronic warfare decoys with increased power and efficiency than achieved with conventional solid state amplifiers. - Continued Field-Plate GaN HEMT Device development for MMW amplifiers. - Continued high-efficiency microwave GaN HEMT amplifier development. - Continued effort to develop W-band high-power GaN Metal-Insulator-Semiconductor (MIS) transistors. - Continued work on GaN MMW components at greater than (>)44 GHz to allow for Extremely High Frequency (EHF) satellite communications (SATCOM) insertion and other MMW applications spanning to 95GHz. - Continued the expansion of scope of the GaN MMW device program. - Continued component development in support of multifunctional electronic warfare. - Initiated transition of GaN high-efficiency microwave HEMT amplifiers to radar and communications applications. - Initiated development of MMW High efficiency amplifiers for satellite communications and compact high efficiency MMW sources for active denial systems. - Initiated development of high-efficiency broadband GaN HEMT amplifiers for electronic warfare applications. - Initiated Sub-MMW GaN Device technology for communications, target identification and high speed data processing. *FY 2009 Plans:* High Efficiency, Highly Linear Amplifiers for Microwave, Millimeter-Wave, Low-Noise, and Power Applications: - Continue all efforts of FY 2008. - Complete high efficiency microwave GaN HEMT amplifier development. Note: In addition to being performed here in FY 2009 the following efforts also transfer to the newly-created Solid State Electronics activity in FY 2010. - Continue development of MMW AlGaN/GaN wide bandgap HEMT.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continue development of AlGaN HEMT broadband amplifiers for electronic warfare decoys with increased power and efficiency than achieved with conventional solid state amplifiers. - Continue MMW field plate GaN HEMT development. - Continue work on GaN MMW components at >44 GHz to allow for EHF SATCOM insertion and other MMW applications spanning to 95GHz. - Continue the expansion of scope of the GaN MMW device program. - Continue component development in support of multifunctional electronic warfare. - Continue transition of GaN high-efficiency microwave HEMT amplifiers to radar and communications applications. - Continue development of MMW high efficiency amplifiers for satellite communications and compact high efficiency MMW sources for active denial systems. - Continue development of high-efficiency broadband GaN HEMT amplifiers for electronic warfare applications. - Continue Sub-MMW GaN Device technology for communications, target identification and high speed data processing. - Initiate Sub-MMW GaN amplifier development.					
SUPPORTING TECHNOLOGIES Supporting Technologies provide 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, smart weapons, networked sensors, and precision time and navigation systems. Supporting Technologies is characterized by research outside of radio frequency (RF) amplifiers, with emphasis in superconducting electronics and nanoelectronics technology. The technology developed which includes nanotechnology cannot, for the most part, be obtained through commercial off the shelf systems (COTS) as a result of the requirements placed on power, frequency, linearity, bandwidth, weight, and size. The current specific objectives are: a) Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest Anywhere in the Electromagnetic Spectrum: Develop sensors for the purpose of detection, localization,		5.444	5.232	0.000	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
and identification of hostile signals of interest anywhere in the electromagnetic spectrum to provide autonomous and persistent Intelligence, Surveillance, and Reconnaissance (ISR) to forward deployed forces and detecting/identifying terrorists/hostiles and their communications networks. b) Countermeasures and Techniques to Defeat Advanced Radio Frequency (RF) Guided Threats: Develop countermeasures and techniques to defeat advanced radio frequency (RF) guided threats to protect high value assets from advanced weapon attack, develop forward deployed jamming systems to negate advanced RF surveillance systems, and deny enemy usage of Global Positioning System (GPS) navigation. c) Solid State Transistors and Devices for High Frequency Analog and Digital Operation: Develop solid state transistors and devices for high frequency analog and digital operation. d) Superconducting Electronics: Develop components for RF systems utilizing superconducting and other technologies which are designed to deliver software defined, wide band, many simultaneous signal functionality over a wide range of frequencies, in increasingly field-ready packaging and demonstrate the ability of these components to be combined into chains to deliver superior functionality in conventional system contexts, including, but not limited to, satellite communications (SATCOM), EW, signal intelligence (SIGINT), and communications. e) Control, Reception, and Processing of Signals: Develop electronics technology that provides for the control, reception, and processing of signals. f) Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures: Develop novel nanometer scale (feature size at or below 10nm) logic/memory devices and related circuits and architectures to deliver ultra-low power, light weight and high performance computational capability for autonomous vehicles and individual warfighters. g) New Concepts for Ultrasensitive, Nano-Based Sensors: Develop new concepts for ultrasensitive, nano-based sensors.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
All FY 2010 efforts in this activity have been transferred to the newly-created Solid State Electronics activity to provide for better alignment with future naval needs. *FY 2008 Accomplishments:* Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest Anywhere in the Electromagnetic Spectrum: - Initiated the development of techniques to identify and exploit the processing vulnerability of passive location systems. Countermeasures and Techniques to Defeat Advanced Radio Frequency (RF) Guided Threats: - Initiated the development to assess the electronic protection capability of modern missiles using advanced processing and investigated the improvements needed to restore countermeasures effectiveness. - Completed the development of analysis/modeling infrastructure and prototype improvement concepts for electronic countermeasures and counter-targeting against RF surveillance threats. Solid State Transistors and Devices for High frequency Analog and Digital Operation: - Continued development of 6.2-6.3 Angstrom Heterojunction Bipolar Transistor (HBT) operating at microwave frequencies. - Initiated development of Antimony (Sb)-based diodes and multipliers for the exploitation of the frequency spectrum from 94-1000 GHz. Superconducting Electronics: - Continued development of a second generation superconducting digital channelizer which includes a 1xk multiplier.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

- Continued demonstration of an improved signal processing technique that can be applied to state-of-the-art L, S, X, and Ka-band superconducting bandpass analog-to-digital converters (ADCs) to realize an improvement in dynamic range of greater than 6 decibels (dB).
- Completed demonstration of a current recycling technology for superconducting digital circuits that is mature enough to yield a four fold reduction of bias current.
- Continued proof of concept lab demonstration of a wideband, high dynamic range combined LNA and antenna, based on arrays of superonducting quantum interference devices (SQUIDs) on a 1 centimeter squared (cm2) chip for frequencies below 200 megahertz (MHz).

Control, Reception, and Processing of Signals:
- Initiated development of an integrated tunable frequency selective and low noise integrated module.

Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures:
- Initiated development of Cellular Nonlinear Network (CNN) processing techniques for unmanned air vehicle (UAV) landing applications.
- Continued effort to develop a highly linear, low-noise RF amplifier using aligned arrays of single-walled carbon nanotubes.
- Initiated development of three dimensional (3D)-integrated CNN image sensing processing architecture research.

New Concepts for Ultrasensitive, Nano-Based Sensors:
- Completed effort to develop carbon nanotube sensors for trace-level vapor detection of explosives, chemical agents, and toxic industrial chemicals.

FY 2009 Plans:

Note: In addition to being performed here in FY 2009, the following efforts also transfer to the Electronic Warfare Activity in FY 2010.

Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest Anywhere in the Electromagnetic Spectrum:

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continue development of techniques to identify and exploit the processing vulnerability of passive location systems. Countermeasures and Techniques to Defeat Advanced Radio Frequency (RF) Guided Threats: - Continue development to assess the electronic protection capability of modern missiles using advanced processing and investigated the improvements needed to restore countermeasures effectiveness. Note: In addition to being performed here in FY 2009, the following efforts also transfer to the newly created Solid State Electronics Activity in FY 2010. Solid State Transistors and Devices for High Frequency Analog and Digital Operation: - Continue development of Antimony (Sb)-based diodes and multipliers for the exploitation of the frequency spectrum from 94-1000 GHz. - Initiate effort to develop W-band high-power Gallium Nitride (GaN) Metal Insulator Semiconductor (MIS) transistors. Superconducting Electronics: - Continue demonstration of an improved signal processing technique that can be applied to state-of-the-art L, S, X, and Ka-band superconducting bandpass ADCs to realize an improvement in dynamic range of greater than 6dB. - Continue proof of concept lab demonstration of a wideband, high dynamic range combined LNA and antenna, based on arrays of superonducting quantum interference devices (SQUIDs) on a 1 centimeter squared (cm2) chip for frequencies below 200 megahertz (MHz). - Continue development of a second generation superconducting digital channelizer which includes a 1xk multiplier. Control, Reception, and Processing of Signals: - Continue development of an integrated tunable frequency selective and low noise integrated module. Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures:				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continue development of Cellular Nonlinear Network (CNN) processing techniques for unmanned air vehicle (UAV) landing applications. - Continue effort to develop a highly linear, low-noise RF amplifier using aligned arrays of single-walled carbon nanotubes. - Continue development of three dimensional (3D)-integrated CNN image sensing processing architecture research.					
SURVEILLANCE TECHNOLOGY (FORMERLY RF SURVEILLANCE TECHNOLOGY) The overarching objective of this activity is to develop 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 and includes modeling and simulation required to support the development of these technologies. The current specific objectives are: a) Radar Architectures, Sensors, and Software which Address Ballistic Missile and Littoral Requirement Shortfalls: Develop radar architectures, sensors, and software which address Ballistic Missile and Littoral requirement shortfalls including: sensitivity; clutter rejection; and flexible energy management. b) Algorithms, Sensor Hardware, and Signal Processing Techniques for Automated Radar Based Contact Mensuration and Feature Extraction: Develop algorithms, sensor hardware, and signal processing techniques for automated radar based contact mensuration and feature extraction in support of asymmetric threat classification and persistent surveillance and to address naval radar performance shortfalls caused by: man-made jamming and Electronic Counter Measures (ECM), unfavorable maritime conditions, and atmospheric and ionosphere propagation effects. c) Software and Hardware for a Multi-Platform, Multi-Sensor Surveillance System: Develop software, and hardware for a multi-platform, multi-sensor surveillance system for extended situational awareness of the battlespace.		12.728	8.640	9.120	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
d) Small UAV Collision Avoidance/Autonomy Technology: Develop small UAV collision avoidance/ autonomy technology. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. The decrease from FY 2008 to FY 2009 is due to the initiation via reprogramming and completion during FY 2008 of preliminary Applied Research required to support the Integrated Topside (INTOP) Innovative Naval Prototype effort. The INTOP multi-year Advanced Technology Development effort initiates in FY 2009 in PE 0603271N. *FY 2008 Accomplishments:* Radar Architectures, Sensors, and Software which Address Ballistic Missile and Littoral Requirement Shortfalls: - Continued the Horizon Extension Sensor System (HESS) project with form factored integration of High Power Amplifier (HPA) and development of a Silicon Germanium (SiGe) downconverter in support of HESS and Digital Array Radar (DAR) efforts. - Continued an element level DAR effort on down conversion and digital beam formers. - Completed the design and development of a field probe and radome assembly for a real-time calibration technique that will utilize an optical-to-radio frequency (RF) distribution network to inject a low-level RF continuous wave (CW) signal into each element of a phased array. Demonstrated the polarization properties of a wideband probe using a zero-bias optical detector. Algorithms, Sensor Hardware, and Signal Processing Techniques for Automated Radar Based Contact Mensuration and Feature Extraction: - Continued development efforts to demonstrate signal processing, waveform generation and one dimensional active phased array apertures for harbor surveillance and situational awareness. - Continued demonstrations of advanced Non-Cooperative Target Recognition (NCTR) algorithms in congested harbor environments.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

- Continued a program to develop and demonstrate methodologies that provide small threat radar detection in the presence of large masking radar returns using an Adaptive Pulse Compression technique.
- Continued the assessment of vulnerabilities of modern side lobe canceling (SLC) algorithms to adversary jamming and develop mitigating SLC design improvements.
- Initiated the development of a process to detect hostile camouflaged or hidden targets in shadows and diverse backgrounds of militarily challenged environments.

Software and Hardware for a Multi-Platform, Multi-Sensor Surveillance System:
- Initiated the development of signal processing techniques to improve situational awareness and autonomous detection of hostile fire events in a dynamic urban clutter environment.

FY 2009 Plans:

Radar Architectures, Sensors, and Software which Address Ballistic Missile and Littoral Requirement Shortfalls:
- Continue all efforts of FY 2008 less those noted as completed above.
- Initiate the requirements analysis and trade studies of an Advanced Common Radar Architecture.

Algorithms, Sensor Hardware, and Signal Processing Techniques for Automated Radar Based Contact Mensuration and Feature Extraction:
- Continue all efforts of FY 2008.
- Complete a program to develop and demonstrate methodologies that provide small threat radar detection in the presence of large masking radar returns using an Adaptive Pulse Compression technique.
- Initiate investigation of means of optimally combining mensuration, classification, and non-cooperative target recognition of surface craft.

Software and Hardware for a Multi-Platform, Multi-Sensor Surveillance System:
- Continue all efforts of FY 2008.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Small UAV Collision Avoidance/Autonomy Technology: - Initiate development of research technologies and analytical algorithms for an effective and highly reliable collision avoidance system. *FY 2010 Plans:* Radar Architectures, Sensors, And Software which Address Ballistic Missile and Littoral Requirement Shortfalls: - Continue all efforts of FY 2009. - Initiate development of a millimeter wave active/passive identification sensor. Algorithms, Sensor Hardware, and Signal Processing Techniques for Automated Radar Based Contact Mensuration And Feature Extraction: - Continue all efforts of FY 2009 less those noted as completed above. - Complete the assessment of vulnerabilities of modern side lobe canceling (SLC) algorithms to adversary jamming and develop mitigating SLC design improvements. - Initiate development of a technology architecture for the Persistent Autonomous Surveillance System. - Initiate development of automated controls for an airborne persistent multi-node sensor network. Software and Hardware for a Multi-Platform, Multi-Sensor Surveillance System: - Complete the development of signal processing techniques to improve situational awareness and autonomous detection of hostile fire events in a dynamic urban clutter environment. Small UAV Collision Avoidance/Autonomy Technology: - Continue all efforts of FY 2009.					
VACUUM ELECTRONICS POWER AMPLIFIERS (FORMERLY RF VACUUM ELECTRONICS POWER AMPLIFIERS) The overarching objective of this activity is to develop millimeter wave (MMW) and sub-MMW 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		2.906	2.908	3.590	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

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, electronic warfare and high-power radar applications at MMW and upper-MMW regime. The emphasis is placed on achieving high power at high frequency in a compact form factor. Technologies include utilization of spatially distributed electron beams in amplifiers, such as sheet electron beams and multiple-beams, and creation of simulation based design methodologies based on physics-based and geometry driven design codes. The current specific objectives are:

a) High Power Millimeter and Upper Millimeter Wave Amplifiers: Develop science and technology for high power millimeter and upper millimeter wave amplifiers including high current density diamond cathodes, sheet and multiple electron beam formation and mode suppression techniques in overmoded structures.

b) Lithographic Fabrication Techniques: Develop lithographic fabrication techniques for upper-millimeter wave amplifiers.

c) Accurate and Computationally Effective Device-Specific Multi-Dimensional Models for Electron Beams: Develop accurate and computationally effective device-specific multi-dimensional models for electron beam generation, large-signal and stability analysis to simulate device performance and improve the device characteristics.

The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.

Funds increase in FY 2010 associated with increased activity and investment in Vacuum Electronics research at the Naval Research Laboratory specific to coupled-cavity 2D algorithms.

FY 2008 Accomplishments:
High Power Millimeter and Upper Millimeter Wave Amplifiers:
- Continued research effort on generation and transport of sheet beam with 5:1 aspect ratio.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Completed research on three dimensional (3D) modeling of beam transport with quadrapole magnetic focusing for high power Ka band Traveling Wave Tube (TWT). - Completed effort on experimental demonstration of beam propagation with quadrapole magnetic focusing that will result in a factor of 3 reduction in magnet volume and weight compared to Permanent Periodic Magnet (PPM) focusing system. Accurate and Computationally Effective Device-Specific Multi-Dimensional Models for Electron Beams: - Continued effort on the gun/collector code MICHELLE with improved interface with the large signal codes CHRISTINE and Telegrapher's Equation Solution for Linear Amplifiers (TESLA). - Continued the effort on developing algorithms and models in large signal code TESLA for multiple beam klystrons. - Continued the effort on developing and implementing models for multi-gap cavity coupling in TESLA for klystrons. - Completed the effort on the development and implementation of models and algorithms for electron emission physics in gun/collector code MICHELLE. - Completed the effort on developing algorithms and models in 1D CHRISTINE_CC for coupled cavity (CC) TWT's. - Initiated the effort on the development and implementation of models and algorithms in the large signal CHRISTINE 3D code to create capabilities for an end-to-end analysis of a Helix TWT. - Initiated the effort on the development and implementation of models and algorithms in a large signal klystron code to model sheet electron beam – wave interaction. - Initiated the effort on developing models and algorithms based on generalized model expansion (GENOME) techniques for large signal modeling of extended interaction klystrons (EIK). *FY 2009 Plans:* High Power Millimeter and Upper Millimeter Wave Amplifiers: - Continue all efforts of FY 2008 less those noted as completed above. - Complete research effort on generation and transport of sheet beam with 5:1 aspect ratio. - Initiate the development of high-current-density cathodes based on diamond current amplifier.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate effort to produce a compact, high-power, W-band amplifier by developing an extended interaction klystron circuit that will be mated to a novel sheet-beam gun, permanent magnet & collector. - Initiate the development of new spatially-distributed electron beam traveling-wave amplifier structures incorporating novel mode suppression techniques. Lithographic Fabrication Techniques: - Initiate effort to develop 220 GHz millimeter-wave amplifiers employing electromagnetic structures that are microfabricated using lithographic techniques. Accurate and Computationally Effective Device-Specific Multi-Dimensional Models for Electron Beams: - Continue all efforts of FY 2008 less those noted as completed above. - Complete the effort on developing and implementing models for multi-gap cavity coupling in TESLA for klystron. - Initiate the effort on the development and implementation of models and algorithms in a large signal TWT code to model sheet electron beam – wave interaction. - Initiate the effort on the development of nonlinear stability analysis for broadband CC-TWT. *FY 2010 Plans:* High Power Millimeter and Upper Millimeter Wave Amplifiers: - Continue all efforts of FY 2009 less those noted as completed above. Lithographic Fabrication Techniques: - Continue all efforts of FY 2009. Accurate and Computationally Effective Device-Specific Multi-Dimensional Models for Electron Beams: - Continue all efforts of FY 2009 less those noted as completed above. - Complete nonlinear stability analysis for the broadband CC-TWT. - Complete an end-to-end analysis of a Helix TWT using the large signal CHRISTINE 3D code. - Initiate development of coupled-cavity 2D algorithms in TESLA for the CC-TWT.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601102A/Defense Research Sciences									Continuing	Continuing
PE 0601102F/Defense Research Sciences									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602114N/Power Projection Applied Research									Continuing	Continuing
PE 0602123N/Force Protection Applied Research									Continuing	Continuing
PE 0602204F/Aerospace Sensors									Continuing	Continuing
PE 0602702F/ Command Control and Communications									Continuing	Continuing
PE 0602716E/Electronics Technology									Continuing	Continuing
PE 0603114N/Power Projection Advanced Technology									Continuing	Continuing
PE 0603123N/Force Protection Advanced Technology									Continuing	Continuing
PE 0603271N/ Electromagnetic Systems Advanced Technology									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602271N ELECTROMAGNETIC SYSTEMS APPLIED RESEARCH	PROJECT NUMBER 0000

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Performance Metrics are discussed within the R-2a.

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	52.499	51.538	48.750						Continuing	Continuing
0000: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	52.499	51.538	48.750						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE provides the unique, fundamental programmatic instrument by which basic research on the natural environment is transformed into technological 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 technological 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 BSE 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.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	**R-1 ITEM NOMENCLATURE** PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	53.967	47.278	51.422	
Current BES/President's Budget	52.499	51.538	48.750	
Total Adjustments	-1.468	4.260	-2.672	
Congressional Program Reductions		-0.140		
Congressional Rescissions				
Total Congressional Increases		4.400		
Total Reprogrammings	-1.166			
SBIR/STTR Transfer	-0.302			
Program Adjustments			-2.108	
Rate/Misc Adjustments			-0.564	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **AUTONOMOUS MARINE SENSORS AND NETWORKS FOR RAPID LITTORAL ASSESSMENT**	1.549	1.596
Project: 9999, **AUTONOMOUS UNDERSEA VEHICLE APPLICATIONS CENTER**	1.166	0.000
Project: 9999, **EXTENDED UNDERWATER OPTICAL IMAGING**	0.000	1.994
Project: 9999, **LITTORAL BATTLESPACE SENSING (LBS) & AUTONOMOUS UNDERWATER VEHICLE SYSTEM (UAV) PROGRAM**	0.965	0.798
Project: 9999, **UNDERWATER ACOUSTIC IMAGING FOR MARITIME DOMAIN AWARENESS**	0.967	0.000

Change Summary Explanation

Technical: Not applicable

Schedule: Not applicable

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH					PROJECT NUMBER 0000	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
0000: OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	52.499	51.538	48.750						Continuing	Continuing

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. Furthermore, this technical base provides developments that may be utilized in the Future Naval Capabilities 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: gaining real-time knowledge of the BSE, determining the natural environment needs of regional warfare, providing the on-scene commander with the capability to exploit the environment to tactical advantage and, 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, 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.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
COASTAL GEOSCIENCES/OPTICS	9.124	6.169	5.926	
The goal of this activity is to determine the sources, distribution, and natural variability (concentration and properties) of optically important matters in the coastal ocean in support of Naval Mine, Undersea, and Special Warfare. Research investments in this activity support the development and testing of expendable				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Decrease from FY 2008 to FY 2009 is due to a realignment of funding to the Marine Mammal and Biology R-2 Activity in support of CNO requirements, and to reflect an overall trend in program direction toward ocean science. *FY 2008 Accomplishments:* - Continued bioluminescence sensor effort with emphasis on needs of the Special Warfare (SPECWAR) forces and Naval Oceanographic Office 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. - Continued efforts to use space-based optical sensors as input for both active and passive optical MCM sensor performance prediction models. - Continued development of innovative naval biosensors, biomaterials, and bioprocess technology. - Continued engineering development and optimization of sea-floor sediment energy harvesting system for sustainable and autonomous powering of underwater sensor networks (coordinated with NRL Benthic Unattended Generator effort in this area). - Continued development of bio-sensors, -materials, and –process technology, with a focus on development of marine mammal pathogen diagnostics (for bacteria, viruses and fungal infections) to support Navy's Fleet Marine Mammal Systems. (Transfers to 0602236N in FY08) - Continued engineering development and optimization of sea-floor sediment energy harvesting system for sustainable and autonomous powering of underwater sensor networks (coordinated with NRL Benthic Unattended Generator effort in this area). (Transfers to 0602236N in FY08) - Continued a program to develop systems to monitor marine mammals during fleet activities using 1) passive acoustic sensors on autonomous underwater vehicles and 2) through radar signal processing algorithms.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued behavioral response studies to develop threshold criteria for marine mammal reactivity to naval sonars and other manmade sound sources of interest. - Continued development and testing of an underwater geo-magnetic noise model. - Continued development of adaptive algorithms to improve MCM EO sensor performance. - Continued to refine algorithms that fuse sediment information extracted from operational sonar with historical sediment databases. - Continued development of a Benthic Unattended Generator to power an autonomous ocean environmental profiler and provided demonstration. - Continued experiments (and data collection) to test user performance as a function of display clutter. - Continued development of small satellite calibration targets to determine atmospheric drag due to neutral density via Light Detection and Ranging (LIDAR) remote sensing. - Initiated at-sea demonstration of radar and acoustics systems to monitor marine mammals in fleet activities. This effort moves to the Marine Mammals and Biology R2 activity in FY 2009. - Initiated efforts to develop visible/near infrared hyperspectral imagery algorithms for autonomous, near real time, retrieval of environmental products, such as diver visibility, bottom type and reflectivity, and bathymetry. - Initiated efforts to develop automatic coordination and utilization of distributed web services. - Completed refining algorithms that fuse sediment information extracted from operational sonars with historical sediment databases. - Completed development of a Benthic Unattended Generator to power an autonomous ocean environmental profiler and provide demonstration. *FY 2009 Plans:* – Continue all efforts of FY 2008 less those noted as completed above. - Complete tracking analysis of small satellite calibration targets to determine atmospheric drag due to neutral density via LIDAR remote sensing. - Initiate effort to understand and predict how power harvesting from the seabed is controlled by sediment geochemistry, microbiology, physical properties, and energetics.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate effort to develop and evaluate an integrated multi-sensor suite, including a small microflow cytometer, to characterize optical and biological properties of subsurface particle layers in coastal waters using unmanned underwater glider technology. - Initiate effort to develop an intelligent decluttering algorithm (or system of algorithms) that accounts for both global and local clutter metrics in complex, multivariate displays. - Initiate effort to develop a next generation atmospheric correction algorithm which will greatly enhance ocean passive retrievals including ocean color and visibility, bathymetry and sea surface temperature. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. - Complete effort to develop visible/near infrared hyperspectral imagery algorithms for autonomous, near real time, retrieval of environmental products, such as diver visibility, bottom type and reflectivity, and bathymetry. - Complete effort to develop automatic coordination and utilization of distributed web services. - Complete bioluminescence sensor effort with emphasis on needs of the Special Warfare (SPECWAR) forces and Naval Oceanographic Office 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. - Initiate development of riverine expert system for environmental characterization.					
MARINE MAMMALS AND BIOLOGY This activity consolidates and expands research conducted in previous years in Coastal Geosciences/ Optics and the Physical Oceanography Activities and expands these efforts. The sensitivity of Marine Mammals to sound produced by Naval operations and training will continue. This program is to assure that Navy decisions can be based on scientifically defensible positions. The goal of this activity is to support: (1) marine mammal research related to understanding impacts of sound (especially sonar) on marine mammal behavior, hearing, physiology, distributions and ecology; (2) development and testing of new technologies for the detection of marine mammals at sea; (3) research on the bio-acoustic properties, use of sound for detection of, and effects of sound on fish and lesser marine		0.000	5.477	4.999	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

organisms; and (4) research on optically important biota in the coastal ocean in support of Naval Mine, Undersea, and Special Warfare (including oceanic bioluminescence and the development and testing of bioluminescence sensors).

The marine mammals research conducted in this PE represents part of a total effort executed in coordination with complementary research performed in PE 0602747N.

FY 2009 reflects the realignment of funds from the Coastal Geosciences/Optics R2 Activity to fund expansion of the marine mammal noise study/mitigation effort per CNO requirement and to reflect an overall trend in program direction toward ocean sciences.

FY 2009 Plans:
- Complete an accelerated effort for marine mammal detection involving signal processing of surface radar and the use of autonomous vehicles to allow passive acoustic and electromagnetic detection and monitoring of marine mammals off ranges during fleet ASW experimentation exercises and demonstrations when sound is transmitted underwater. (This effort transitioned from the Coastal Geosciences/Optics R2 activity).
- Initiate multi-investigator, coordinated field research to test responses of marine mammals (especially beaked whales) to controlled sound exposures.
- Initiate development of new technologies for detection and localization of marine mammals, including (but not restricted to) gliders equipped with passive acoustic sensors, radar and thermal imagery.
- Initiate research examining hearing sensitivity of marine mammals (including temporary and permanent threshold shifts).
- Initiate research efforts examining distributions and abundances of marine mammals relative to prey fields and basic oceanographic parameters.
- Initiate development of and evaluate models that predict time- and space-dependent sound fields produced by anthropogenic noise sources and mammal responses to the noise.
- Initiate development and testing of multi-frequency acoustic technologies for detection, identification and enumeration of fish.
- Initiate research to examine sensitivity of fish to anthropogenic sound.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate research leading to better predictability of bioluminescent and pigment-bearing planktonic organisms. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above.					
MARINE METEOROLOGY 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, EM and EO propagation, coastal meteorology, Tropical Cyclone (TC) 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 TC 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. *FY 2008 Accomplishments:* - Continued developments in atmospheric effects on EMs and EOs because of the central importance of EM and EO propagation to many modern warfare systems. - Continued development of an EO propagation model that accounts for the atmospheric effects of near-surface refraction, scintillation, aerosol extinction, illumination and target, background and sensor characteristics for incorporation into EO tactical decision aids and for supporting warfare systems development. - Continued application of predictability concepts to optimize use of new-generation satellite data to target observation selection for maximum forecast impact in military areas of interest.		11.459	11.409	11.063	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued exploitation of optimal methods for capturing uncertainty of environmental predictions on regional and local scales for reliability estimates of tactical parameters. - Continued program to develop the ability to assimilate data from the next generation of operational weather satellites to benefit real-time analysis of the battlespace environment as well as improving the global forecasting skill. - Continued development and validation of the Advanced Propagation Model to account for atmospheric effects on EM radiation, in particular, by the addition of the capability to describe high frequency radio frequencies. - Continued development of new methods, which account for a wider range of atmospheric conditions, for determination of refractivity from clutter as an inverse method of obtaining the critical refractivity properties of the atmosphere that affect EM propagation. - Initiated effort to exploit probabilistic parameter ensembles for model improvement and construct a basis for observation-informed stochastic model integration. - Initiated effort to improve understanding of atmospheric physical processes in the Arctic. - Continued effort to optimize rapid environmental assessment using coupled air-sea systems to support multiple warfare and mission areas, with a particular emphasis on Special Warfare. - Continued the development of a real-time meteorological and oceanographic battlespace characterization capability (NOWCAST) that collects, processes and exploits on-scene environmental data for rapid environmental assessment. The system will combine high-resolution atmospheric forecast information with 4-D data assimilation of on-scene observations (radar, satellite, conventional observations, etc) for customized display at time and space scales relevant for tactical operation support. - Continued the development of global and mesoscale aerosol/radiation models that account for the major sources (desert dust, sea spray, biomass burning, industrial pollution) of visibility degradation in the atmosphere and integrate with numerical weather prediction systems for an aerosol predictive capability that can support militarily relevant time and space scales. - Continued the development and validation of a next-generation TC model that can analyze, initialize, and predict TC position, structure and intensity, using a high-resolution (< 3 km) mesoscale model. The development will leverage emerging data assimilation and modeling techniques as well as observational results from the scientific community to build upon existing modeling capabilities.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated development of methods to retrieve and assimilate remotely-sensed aerosol data into aerosol prediction models. - Merged multiple data sources (radar and optical) of resident space objects (from 1st flight) for improved precision orbit determination (~25%) and prediction (~15%). *FY 2009 Plans:* - Continue all efforts of FY 2008. - Complete the development and validation of a next-generation TC model that can analyze, initialize, and predict TC position, structure and intensity, using a high-resolution (< 3 km) mesoscale model. The development will leverage emerging data assimilation and modeling techniques as well as observational results from the scientific community to build upon existing modeling capabilities. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. - Complete development of new methods, which account for a wider range of atmospheric conditions, for determination of refractivity from clutter as an inverse method of obtaining the critical refractivity properties of the atmosphere that affect EM propagation. - Complete effort to optimize rapid environmental assessment using coupled air-sea systems to support multiple warfare and mission areas, with a particular emphasis on Special Warfare. - Complete the development of a real-time meteorological and oceanographic battlespace characterization capability (NOWCAST) that collects, processes and exploits on-scene environmental data for rapid environmental assessment. The system will combine high-resolution atmospheric forecast information with 4-D data assimilation of on-scene observations (radar, satellite, conventional observations, etc) for customized display at time and space scales relevant for tactical operation support. - Complete effort to exploit probabilistic parameter ensembles for model improvement and construct a basis for observation-informed stochastic model integration. - Complete effort to improve understanding of atmospheric physical processes in the Arctic. - Complete tracking analysis of small satellite calibration targets to determine atmospheric drag due to neutral density via LIDAR remote sensing.					
NATIONAL OCEANOGRAPHIC PARTNERSHIP PROGRAM (NOPP)		9.782	9.400	9.089	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
This activity focuses on US Navy investments in the NOPP. NOPP, established by the US 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: development of an integrated coastal ocean observation system and development of sensors, communications and data acquisition, storage and processing tools required to affect it, modernization of ocean research and observation infrastructure, and marine mammal-related research. *FY 2008 Accomplishments:* – Continued marine mammal program on noise mitigation – Continued The Partnership for Advancing Interdisciplinary Global Modeling. – Continued Global Ocean Data Assimilation Experiment (GODAE) including assessment of GODAE boundary conditions for use in coastal ocean predictions. - Continued new methods for detection of fish, fish populations and mapping of fish habitat. - Continued development of sensors for sustained, autonomous measurement of chemical or biological parameters in the ocean. - Continued marine mammal program on methods for detection and tracking of marine mammals and mapping their habitat. - Continued and completed wireless communications for the coastal ocean. - Completed Hybrid Coordinate Ocean Model (HYCOM). *FY 2009 Plans:* – Continue all efforts of FY 2008 less those noted as completed above. *FY 2010 Plans:* – Continue all efforts of FY 2009. - Initiate effort to develop global ocean models with sufficient resolution to accurately simulate tides and internal waves to improve the fidelity of ocean prediction systems.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continue real-time forecasting system of winds, waves and surge in TCs. – Complete The Partnership for Advancing Interdisciplinary Global Modeling. – Complete Global Ocean Data Assimilation Experiment (GODAE) including assessment of GODAE boundary conditions for use in coastal ocean predictions. - Complete new methods for detection of fish, fish populations and mapping of fish habitat.					
OCEAN ACOUSTICS 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 Littoral Zone, 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. Increase from FY 2009 to FY 2010 reflects increased level of investment in ocean acoustics research. *FY 2008 Accomplishments:* - Continued development of an integrated hydrodynamic/acoustic propagation modeling capability for littoral regions to predict acoustic ASW system performance in dynamic environments. - Continued development of a TDA that can predict the dynamic oceanographic characteristics of shallow-water internal waves and their effects on underwater acoustic signals. - Continued development of a validated, physics-based processing algorithm that diagnoses acoustic performance directly from oceanographic data.		6.016	6.078	7.450	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued development of a set of physics-based environmental acoustic metrics to evaluate the predictions of TDAs that are used in planning asset allocation and placement of distributed Autonomous Undersea Vehicles (AUVs) in a time evolving scenario. - Continued development of improved performance predictions for sonar surveillance systems that utilize horizontal line arrays operating in shelf-break environments and relate horizontal-array signal gain and coherence length to the statistics and scale lengths of transverse environmental inhomogeneities. - Continued development of glider ocean sampling strategies to minimize acoustic detection range uncertainty for anti-submarine warfare predictions. - Continued development of a broadband, bistatic reverberation time-series simulator for range-dependent underwater environments. - Continued development of an ocean magnetic prediction system for magnetic fields generated by high amplitude internal waves, internal bores, and internal solitary waves. - Demonstrated in Rim of the Pacific 2008 (RIMPAC08) new ASW metrics to plan ASW mission and assess ASW system performance. *FY 2009 Plans:* – Continue all efforts of FY 2008. *FY 2010 Plans:* – Continue all efforts of FY 2009. - Complete development of glider ocean sampling strategies to minimize acoustic detection range uncertainty for anti-submarine warfare predictions. - Complete development of a broadband, bistatic reverberation time-series simulator for range-dependent underwater environments.					
PHYSICAL OCEANOGRAPHY The goal of this activity is to develop naval tactical uses of knowledge of the physics of the ocean within the BSE. 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		11.471	8.617	10.223	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

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, Naval Special Warfare (NSW), Sea-Basing, and mine warfare needs.

Decrease from FY 2008 to FY 2009 is due to a realignment of funding to the Marine Mammals and Biology R2 Activity in support of CNO requirements, and to reflect an overall trend in program direction toward ocean science.

Increase from FY 2009 to FY 2010 reflects increased level of investment in physical oceanography.

FY 2008 Accomplishments:
- 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 development of mass conserving baroclinic finite element models using discontinuous Galerkin methods.
- Continued to extend current theory dealing with tidal variations in sound-speed to sound-speed events with strong range-dependence.
- Continued the development of a data assimilative nearshore modeling capability using measurements to guide hydrodynamic forecasts including data sampling strategies and model sensitivity to data.
- Developed new ocean mixed-layer algorithms for generation of synthetic profiles which has led to the operational implementation of a new system Navy Ocean Sound Speed Prediction (NOSSP) system at the Naval Oceanographic Office.
- Continued the integration of hyperspectral imagery into underwater autonomous vehicles and derive river environmental properties through a combination of models and observations.
- Continued the development and implementation of new techniques for parameterizing fluxes of mass and energy across the air-sea interface in coupled ocean-atmosphere models, to improve operational predictions of the BSE.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued development and testing of acoustic communications, disposable environmental instruments, and Unmanned Undersea Vehicles (UUV) and gliders for NSW mission support. - Continued developing Delft3-D-Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS) to include new options for riverine input and transport and behavior of contaminants in support of NSW mission planning. - Continued development of the knowledge layer of the internal wave tactical decision aid. - Continued development and testing of optimizing remote environmental monitoring units and other autonomous devices for NSW-Meteorological and Oceanographic Command (METOC) uses in assessing METOC conditions and providing data for assimilation. - Continued development and testing of glider uses in ASW METOC, adaptive sampling, and NSW support. - Continued the development of synthetic aperture radar and hyperspectral imagery exploitation for NSW and Marine Expeditionary Forces as well as the support of new riverine units. - Continued studies of the monitoring and evaluation of ocean currents and water mass properties near topographic control points in marginal seas. - Continued to develop improved ocean wave prediction, especially shoaling waves, based on the extensive basic research measurement programs in this area over the past decade. - 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 dependent on other priorities in this area. - Continued development of predictive capability of internal wave affects on the battlespace, including affects on acoustic transmission. - Continued the development of the coupled Delft3d-COAMPS model within the larger naval forecast system for use in NSW mission planning - Continued the development of adaptive sampling algorithms for minimizing acoustic uncertainty using persistent, reconfigurable sampling by UUVs. - Completed Undersea Persistent Surveillance (UPS) effort with field experimentation using ocean gliders to provide water column structure influencing acoustic propagation and allowing adaptation in sampling locations for optimal inputs to ocean predictive models; major in-water experiment in late summer/early				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

fall 2007. The research products from this effort will transition to the Innovative Naval Prototype (INP) Persistent Littoral Undersea Surveillance (PLUS) effort in PE 0603747N.
- Completed the development and implementation of new techniques for parameterizing fluxes of mass and energy across the air-sea interface in coupled ocean-atmosphere models, to improve operational predictions of the battle space environment.
- Completed Phase 1 of the development of adaptive sampling algorithms for minimizing acoustic uncertainty using persistent, reconfigurable sampling by UUVs.
- Initiated on-board processing of METOC data on gliders/UUV for exfiltration consistent with operational concept of operations.
- Initiated the custom installation of adaptive sampling algorithms for minimizing acoustic uncertainty using persistent, reconfigurable sampling by UUVs using Naval Oceanographic (NAVO) modeling systems.
- Initiated effort to develop a coupled, high-resolution, comprehensive ocean prediction system for the study of complex air-sea processes.

FY 2009 Plans:
– Continue all efforts of FY 2008 less those noted as completed above.
- Complete development and testing of glider uses in ASW METOC, adaptive sampling, and NSW support.

FY 2010 Plans:
- Continue all efforts of FY 2009 less those noted as completed above.
- Complete effort to develop a coupled, high-resolution, comprehensive ocean prediction system for the study of complex air-sea process.
- Complete development and testing of glider uses in ASW METOC, adaptive sampling, and NSW support.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	PROJECT NUMBER 0000

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602114N/Power Projection Applied Research									Continuing	Continuing
PE 0602123N/Force Protection Applied Research									Continuing	Continuing
PE 0602235N/Common Picture Applied Research									Continuing	Continuing
PE 0602271N/RF Systems Applied Research									Continuing	Continuing
PE 0602601F/Space Technology									Continuing	Continuing
PE 0602747N/Undersea Warfare Applied Research									Continuing	Continuing
PE 0602782N/Mine and Expeditionary Warfare Applied Research									Continuing	Continuing
PE 0602784A/Military Engineering Technology									Continuing	Continuing
PE 0603207N/Air/Ocean Tactical Applications									Continuing	Continuing
PE 0603271N/RF Systems Advanced Technology									Continuing	Continuing
PE 0603401F/Advanced Spacecraft Technology									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602435N OCEAN WARFIGHTING ENVIRONMENT APPLIED RESEARCH	PROJECT NUMBER 0000

PE 0603747N/Undersea Warfare Advanced Technology		
PE 0603782N/Mine and Expeditionary Warfare Advanced Technology	Continuing	Continuing
PE 0604218N/Air/Ocean Equipment Engineering	Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

All Science and Technology model improvements undergo a rigorous validation, verification and evaluation against quantifiable metrics before being accepted for transition into operations. In Marine Meteorology, for example, typical improvements over the past decade have amounted to a gain in skill of one forecast-day (i.e., the 4-day forecast is now as skillful as the 3-day forecast of a decade ago), and tropical cyclone forecast track error has been reduced by 50%. It is expected that future increases in skill will continue at or above this pace.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602651M JOINT NON-LETHAL WEAPONS APPLIED RESEARCH					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	5.974	6.065	6.008						Continuing	Continuing
0000: JOINT NON-LETHAL WEAPONS APPLIED RESEARCH	5.974	6.065	6.008						Continuing	Continuing

A. Mission Description and Budget Item Justification

The DOD's Joint Non-Lethal Weapons Program (JNLWP) was established by the Secretary of Defense, who assigned centralized responsibility for DOD joint research and development of non-lethal technology to the Commandant of the Marine Corps as the Executive Agent. The Under Secretary of Defense for Acquisition, Technology and Logistics provides direct oversight of the JNLWP.

The efforts described in this Program Element (PE) reflect science and technology (S&T) investment decisions provided by the Joint NLW Integrated Product Team, a multi-service flag level corporate board that executes the JNLWP for the Commandant of the Marine Corps. This direction is based on the needs and capabilities of the Services, the Special Operations Command, and the Coast Guard, as identified in the DoD's Non-Lethal Weapons Joint Capabilities Based Assessment Document. This coordinated joint S&T development approach addresses mutual capability gaps and assures the best non-lethal technologies and equipment are provided to the operating forces while eliminating duplicative service S&T investment.

This program funds the applied research, study, assessment, and demonstration of technologies that could provide a non-lethal capability or target effect. 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 counter-facility applications); 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. This program transitioned from PE 0602114N, Power Projection Applied Research by order of the Under Secretary of Defense for Acquisition, Technology, and Logistics, USD(AT&L), to a separate PE for Joint Non-Lethal Weapons Applied Research and established the Marine Corps as the executive agent for DoD Joint Non-Lethal Weapons RDT&E.

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

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	**R-1 ITEM NOMENCLATURE** PE 0602651M JOINT NON-LETHAL WEAPONS APPLIED RESEARCH

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	5.997	6.084	6.087	
Current BES/President's Budget	5.974	6.065	6.008	
Total Adjustments	-0.023	-0.019	-0.079	
Congressional Program Reductions		-0.017		
Congressional Rescissions				
Total Congressional Increases				
Total Reprogrammings				
SBIR/STTR Transfer	-0.023			
Program Adjustments			-0.085	
Rate/Misc Adjustments		-0.002	0.006	

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602651M JOINT NON-LETHAL WEAPONS APPLIED RESEARCH					PROJECT NUMBER 0000	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
0000: JOINT NON-LETHAL WEAPONS APPLIED RESEARCH	5.974	6.065	6.008						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds the applied research, study, assessment, and demonstration of technologies that could provide a non-lethal capability or target effect. 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 counter-facility applications); 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
JOINT NON-LETHAL WEAPONS APPLIED RESEARCH	5.974	6.065	6.008	
FY 2008 Accomplishments: - Continued examination of target effects/characterization and assessed the resulting crowd behavior and effectiveness of non-lethal acoustic and optical (light stun/distract) technologies. - Continued investigation of the characteristics, optimization, and control of Laser Induced Plasma (LIP) phenomena for its non-lethal applications to both counter-personnel and counter-material missions. LIP is a phenomenon of high energy, short pulse lasers that have several potential applications to produce or transmit non-lethal stimuli. - Continued investigation of several advanced non-lethal material technologies with non-lethal weapons applications, including engine suffocates, morphing materials for new non-lethal rounds or flight bodies, and new non-lethal nano-materials. - Continued refinement of directed energy weapon models through research into non-lethal phenomena and assessment of human effects and weapon effectiveness. - Continued exploration of the use of light and sound combinations to produce non-lethal human effects, to include saccade motion, discomfort and disability glare, flash-blindness, and potential cognitive effects, with level of light/sound stimuli below hazardous levels.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602651M JOINT NON-LETHAL WEAPONS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued applied research in the development of counter-personnel and counter-material directed energy non-lethal weapons, including counter-vehicle and advanced active denial activities. - Completed the Advanced Total Body Model (ATBM) development effort to enable modeling and simulation of human effects from non-lethal weapons in support of legal, treaty and policy decisions. - Completed exploration of long range, wireless, extended duration electrically induced neuromuscular incapacitation. - Completed examination of specific non-lethal effects and effectiveness associated with the laser-induced plasma phenomenon. - Initiated academic research into technology areas with relevance to non-lethal weapon capabilities. *FY 2009 Plans:* - Continue all efforts from FY 2008, less those noted as completed above. - Complete and transition to higher categories of development the use of light and sound combinations to produce non-lethal human effects, to include saccade motion, discomfort and disability glare, flash-blindness, and potential cognitive effects, with level of light/sound stimuli below hazardous levels. - Initiate investigations of alternative technologies with potential to address emerging capability gaps. - Initiate characterization efforts of alternative directed energy technologies by building upon the ATBM model as part of the Human Effects Modeling Analysis Program (HEAMP) to incorporate suitable sensors capable of measuring directed energy effects (millimeter – wave, high powered microwave, etc). - Initiate investigation of candidate technologies applicable to delivering laser induced plasma effects. *FY 2010 Plans:* - Continue all efforts from FY 2009, less those noted as complete above. - Complete examination of target effects/characterization and assessment of the resulting crowd behavior and effectiveness of non-lethal acoustic and optical (light stun/distract) technologies. - Complete investigation of several advanced non-lethal material technologies with non-lethal weapons applications, including engine suffocates, morphing materials for new non-lethal rounds or flight bodies, and new non-lethal nano-materials. - Complete investigation of the characteristics, optimization, and control of Laser Induced Plasma (LIP) phenomena for its non-lethal applications to both counter-personnel and counter-material missions. LIP				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602651M JOINT NON-LETHAL WEAPONS APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
is a phenomenon of high energy, short pulse lasers that have several potential applications to produce or transmit non-lethal stimuli. - Initiate human effects investigation of alternative physical phenomena to non-lethally suppress humans beyond small arms range. - Initiate feasibility studies for applying promising advanced technologies to address current and projected counter-personnel and counter-material capability gaps.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0603651M/Joint Non-Lethal Weapons Technology Development									Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

The primary objective of this Program Element is the development of technologies that lead to the next-generation of Non-Lethal Weapons. The program consists of a collection of projects that range from studies and analyses to the development and evaluation of feasibility demonstration models. Individual project metrics reflect the technical goals of each specific project. Typical metrics include both the effectiveness of the technology, human effects and effectiveness, and potential for compliance with policy and legislation. Overarching considerations include the advancement of related Technology Readiness Levels and Human Effects Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	71.841	65.187	55.694						Continuing	Continuing
0000: UNDERSEA WARFARE APPLIED RESEARCH	71.841	65.187	55.694						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE funds applied research efforts in undersea target detection, classification, localization, tracking, and neutralization is funded through this 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. Research focused on understanding the impacts on marine mammals of manmade underwater sound is also conducted in the Program Element.

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

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	**R-1 ITEM NOMENCLATURE** PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	71.764	58.658	60.792	
Current BES/President's Budget	71.841	65.187	55.694	
Total Adjustments	0.077	6.529	-5.098	
Congressional Program Reductions		-0.217		
Congressional Rescissions				
Total Congressional Increases		6.800		
Total Reprogrammings	0.526			
SBIR/STTR Transfer	-0.412			
FTT Assessment	-0.037			
Program Adjustments			-5.105	
Rate/Misc Adjustments		-0.054	0.007	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **ADVANCED HIGH ENERGY DENSITY SURVEILLANCE POWER MODULE**	0.775	2.394
Project: 9999, **AUTONOMOUS UNMANNED UNDERSEA VEHICLE (UUV) DELIVERY & COMMUNICATION (AUDAC) IMPLEMENTATION**	1.946	2.792
Project: 9999, **GALFENOL ENERGY HARVESTING**	1.543	1.596

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH					PROJECT NUMBER 0000	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
0000: UNDERSEA WARFARE APPLIED RESEARCH	71.841	65.187	55.694						Continuing	Continuing

A. Mission Description and Budget Item Justification

This PE funds applied research efforts 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 which is one of the core operational concepts detailed in the Naval Transformational Roadmap. Associated efforts focus on new 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 ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
ANTI-SUBMARINE WARFARE (ASW) DISTRIBUTED SEARCH	0.000	0.000	14.124	
ASW Distributed Search focuses the development of technologies for the non-covert tactical search for undersea targets ranging from hours to weeks using automated sensor systems deployed around operating areas including along key transit routes to protect naval/maritime forces, around temporarily fixed sea base regions and naval force operating areas, or around fixed defensive regions and areas of interest such as key US/Allied ports. "Non-covert" implies availability of airborne assets for sensor deployment (although other means may also be used), and the ability to employ active sonar along with passive and non-acoustic methods. "Search" is conducted in concentrated areas, typically exploiting cues received from surveillance systems. The submarine target must be detected beyond its weapons release range. The objective is to develop rapidly deployable systems employing automated detection and classification capabilities for use in both shallow and deep water operating environments. Distributed Search supports the ASW protected passage Maritime Shield operational constructs. Related efforts include the development of distributed systems employing optimization as well as active acoustic sensing and processing techniques, navy-unique transduction and underwater networking technology. Efforts also include the development of Unmanned Undersea Vehicle-based and affordable off-board deployable sensing systems employing persistent detection concepts and components. These efforts provide an				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
extended reach of organic platform-based systems through the use of new sensor concepts, improved materials for advanced sensors, optimized deployment, employment, and automated operation of distributed sensor fields. The cornerstone of Distributed Search is the development of rapidly deployable, long-endurance active sensors with automated processing suitable for use in a wide variety of operational environments. The FY 2009-2010 funding increase is due to the realignment of the Wide Area ASW Surveillance and Battlegroup ASW Defense Activities into this new Activity. *FY 2010 Plans:* The following efforts transferred into this activity from the FY 2009 Wide Area ASW Surveillance activity: - Continue development of signal processing algorithms aimed at reducing clutter-generated false alerts. - Continue development/improvement of multi-static signal processing techniques for systems employing coherent sound sources. - Continue development of “intelligent” algorithms aimed at optimizing distributed multistatic sources/ receivers. - Continue a collaborative follow-on Joint Research Project for Next Generation Autonomous Sensing (NGAS). - Complete research effort to accomplish array shape estimation using fiber-optic interferometric methods. - Initiate research and development of feature-based tracking techniques to improve multi-sensor tracking of quiet submarines in littoral and deep-ocean environments. - Initiate research into the characterization and classification of deep-ocean clutter sources to improve active sonar system performance in Convergence Zone (CZ) and other deep-ocean propagation conditions. - Initiate development of Non-Traditional Transduction Methods (NTTM) which fundamentally departs from conventional ASW transduction techniques. - Initiate development of Non-Acoustic Fiber Optic Sensors (NA-FOS) for ASW applications. - Initiate research aimed at adaptive design and synthesis of networked distributed sensors.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate effort to demonstrate the effectiveness of structural acoustic-based classifier techniques to detect, localize and identify. The following efforts contribute to the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area: - Continue an applied research effort to improve distributed system processing techniques and capabilities. - Initiate development of high fidelity computer-based simulation training with linked architecture that supports ASW training from the operator-level to the ASW Commander-level applicable to both surface and air platforms. The following efforts transferred into this activity from the FY 2009 Battlegroup ASW Defense activity: - Continue 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. - Continue development of improved techniques to distinguish submarine echoes from those produced by ocean bottom features. - Continue design and development of underwater projectors using structural magnetostrictive materials. - Continue dipole projector array design and development. - Continue compact low frequency projector developments. - Continue single crystal and hybrid projector design and development.					
ANTI-SUBMARINE WARFARE (ASW) PERFORMANCE ASSESSMENT The goal of this work is to integrate ocean and atmospheric environmental characteristics with sensor performance predictions in order to develop algorithms and Tactical Decision Aids (TDAs) that will accurately predict overall sensor performance in a given environment in near real-time for both present and future situations. The results of these research efforts in conjunction with embedded state-of-the-art command and operator-level training will facilitate the optimum employment of ASW sensor systems, thus increasing their effectiveness and potentially decreasing the number of sensors used to provide coverage in a given area. This work will provide operational commanders with sensor performance predictions which		0.000	0.000	4.036	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
allow them to accurately judge the performance of those sensors, as well as information with which to deploy them for the greatest operational effect. It will also provide information as to how the performance evolves over time due to effects such as the deformation of sensor locations by currents, sound velocity profile changes, geologic magnetic interference changes, or changes to the optical properties of the water, etc. The effort includes performance predictions for fields of sensors as well as individual sensors themselves and applies to both acoustic and non-acoustic sensors. Work includes development of ASW sensor and system performance models, and realistic simulations and measures of effectiveness that incorporate and exploit critical environmental knowledge. It includes efforts to couple ocean dynamics and acoustics, characterize ambient noise in the littorals, measure and model acoustic and optical propagation and scattering in complex environments, develop algorithms to extract environmental information from through-the-sensor measurements and quantification and prediction of uncertainty. This information is combined with the operating characteristics of particular sensors (or groups of sensors) to provide predictions of sensor performance in the environment at that particular time and in the future. The predictions will also include assessments of the prediction uncertainty due to environmental measurement and sensor performance uncertainties. This work aligns principally with the Assure Access and Hold at Risk S&T Focus Area in the Naval S&T Strategic Plan and contributes measurably to the Operational Environments S&T Focus Area strategic objectives. The FY 2009-2010 funding increase is due to the realignment of Wide Area ASW Surveillance activity into this new activity. *FY 2010 Plans:* The following efforts transferred to this activity from the FY 2009 Wide Area ASW Surveillance activity: - Complete development of models that accurately characterize short and long range forward scattering from the ocean boundaries for surveillance through tactical sonar frequencies.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
The following efforts contribute to the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area: - Continue research effort aimed at the ideal placement of acoustic sources and drifting sensor systems using in-situ environmental information and models. - Continue research effort focusing on distributed system in-situational environmental characterization and system monitoring. - Continue research effort to determine the placement of and follow-on control and pattern keeping of mobile sources and distributed sensor systems. - Initiate development of algorithms to extract environmental information from through-the-sensor measurements.				
ANTI-SUBMARINE WARFARE (ASW) PRECISION LOCALIZATION Precision Localization focuses on the development and demonstration of technologies which use information from surveillance or search systems to determine an area of uncertainty (AOU) relative to target range, bearing, and depth adequate to handoff to an attack system. Precision Localization employs non-acoustic techniques such as magnetic sensing and wake trailing to highly localize submerged threats. The objective is to increase magnetic sensor range and robustness, enable deployment on Unmanned Air Vehicles (UAVs), and increase wake trailing search rates. Efforts include the development of non-traditional tracking and advanced magnetic and electric field sensors and processing. These technologies will provide a decreased AOU size thus enabling the effective use of smaller, more versatile torpedoes as well as increased performance gain in detection, targeting, tracking/trailing, and homing via wake acquisition and covert prosecution. The FY 2009-2010 funding increase is due to the realignment of the Wide Area ASW Surveillance Activity into this new Activity.	0.000	0.000	3.656	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2010 Plans: The following efforts were transferred to this new activity from the FY 2009 Wide Area ASW Surveillance activity: - Continue development of a non-traditional tracking system for deployment on undersea vehicles. - Continue testing of a non-traditional tracking system. - Continue development of alternative active optical sources and sensor devices for Non-Acoustic ASW systems. - Continue an effort to extend the technology base for blue laser sources for Undersea Warfare applications including underwater communications. - Continue an effort to extend the technology base for high performance electro-optic detectors suitable for Undersea Warfare applications including underwater communications. - Continue an effort to extend the technology base for high performance electro-optic filters suitable for Undersea Warfare applications including underwater communications. - Continue an effort to develop consistent and comprehensive modeling and simulation tools for photonic Undersea Warfare and underwater communications components and systems. - Continue an effort to develop optical signal processing and hybrid computing technology appropriate for Undersea Warfare and underwater communications systems. - Complete development of spin-dependent tunneling and coupled magnetostrictive/piezoelctric passive magnetometer device technologies. - Initiate development of ASW sensor technologies capable of being deployed by a gun or missile launcher.					
ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE ASW Surveillance focuses on dramatically improving detection, classification, and localization capabilities in large ocean areas relative to the capabilities of legacy ASW surveillance systems. The related technologies support the conduct of covert wide-area surveillance ranging from one day to six months. The objectives are to develop and demonstrate technologies that provide clandestine indications and warnings in far forward and contested operating areas and in complex operational environments against all submarine threats including new threats with unknown target signatures and tactics. Covertness implies		0.000	0.000	13.967	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
use of non-observable platforms and/or deployed automated sensors employing passive sonar or other non-detectable methods. The surveillance process includes initial detection and classification. Efforts include the development of Unmanned Undersea Vehicle-based and affordable off-board deployable sensing systems employing a wide variety of surveillance concepts and components. These efforts focus on alternative detection phenomena, vector/tensor sensors, automated acoustic processing, more compact and longer lasting power sources, and high bandwidth acoustic communications links. The FY 2009-2010 funding increase is due to the realignment of the Wide Area ASW Surveillance and Battlegroup ASW Defense activities into this new activity. *FY 2010 Plans:* The following efforts were transferred to this new activity from the FY 2009 Wide Area ASW Surveillance activity: - Continue development of new acoustic and magnetic sensors for autonomous, networked underwater threat monitoring over large spatial scales. - Continue an applied research effort to improve distributed system processing techniques and capabilities. - Complete design of a "Sea Star" undersea local area network to link peripheral sensors to a centralized node through high-bandwidth, short-haul acoustic communications. - Complete fiber optic technology development to support the next generation of submarine hull arrays including new transducers, optical multiplexing, and optical components. - Initiate development of Non-Acoustic Underwater Communications. - Initiate development of Advanced Imaging Methods (AIM) to provide expanded spatial, temporal and spectral imaging options. - Initiate an effort to research improved seawater electrodes for Underwater Electric Potential (UEP) sensing in ASW applications. - Initiate research the goal of which is to form underwater magnetic sensors into a virtual gradiometric array via non-cabled communications.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
The following Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area efforts were transferred to this new activity from the FY 2009 Wide Area ASW Surveillance activity: - Continue development of technologies to provide rapid localization of threat submarines for On-Demand Detection, Classification and Localization (On-Demand DCL). - Initiate development of a vector sensor towed array and associated signal processing with performance nominally equivalent to a "thin-line" (TB-29) twin-line towed array to be compatible with the existing TB-29 array handling system. The following efforts were transferred to this new activity from the FY 2009 Battlegroup ASW Defense activity: - Continue development of an acoustic/magnetic hybrid sensor. - Continue development of low cost, compact, combined acoustic sensor. - Continue electroactive polymer smart sensor development. - Continue research to improve detection of quiet diesel-electric submarines using passive sonar arrays in deep ocean environments. - Complete development of target classification algorithms that adapt to local shipping noise conditions, thereby reducing false alarm probability. - Complete development of environmentally adaptive target detection and classification algorithms for deep water operating environments. - Initiate research to predict performance of automated passive sonar detection and classification algorithms in shallow and deep ocean environments. - Initiate biomimetic and nano sensor development. - Initiate 'hockey puck' transducer/amplifier module development. - Initiate broadband, directional, high power array development.				
BATTLEGROUP ANTI-SUBMARINE WARFARE (ASW) DEFENSE Battlegroup ASW Defense technology focuses on the development of platform-based sources and receivers aimed at denying submarines the ability to target gray ships. This technology area is primarily	16.152	9.871	0.000	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Research aimed at understanding and predicting the impacts of manmade underwater sound on marine mammals is also conducted in this activity. 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). The FY 2008 to FY 2009 decrease is associated with the movement of funds to establish the new Marine Mammals Activity ($4.3M). The FY 2009 to FY 2010 funding decrease is due to the realignment of this Activity to the newly established ASW Distributed Search and Surveillance Activities in FY 2010. *FY 2008 Accomplishments:* - 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 design and development of underwater projectors using structural magnetostrictive materials. - Continued development of improved techniques to distinguish submarine echoes from those produced by ocean bottom features. - Continued development of an acoustic/magnetic hybrid sensor. - Continued development of low cost, compact, combined acoustic sensor. - Continued electroactive polymer smart sensor development. - Continued dipole projector array design and development. - Continued compact low frequency projector developments. - Completed development of advanced sonar signal processing algorithms that integrate target classification and tracking into a combined system for autonomous deployable sensor processing. - Initiated development of target classification algorithms that adapt to local shipping noise conditions, thereby reducing false alarm probability. - Initiated development of environmentally adaptive target detection and classification algorithms for deep water operating environments.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated an accelerated effort for marine mammal detection involving signal processing of surface radar and the use of autonomous vehicles to allow passive acoustic and electromagnetic detection and monitoring of marine mammals off ranges during fleet ASW experimentation exercises and demonstrations when sound is transmitted underwater. This effort transfers to the newly established Marine Mammals Activity in FY 2009. The following efforts contribute to the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area: - Continued development of signal processing and system control algorithms for the AN/WSQ-11 “Tripwire” torpedo protection system. (Transferred to PE 0603123N) - Continued development of an AN/WSQ-11 “Tripwire” testbed for the testing of algorithms. (Transferred to PE 0603123N) - Completed a focused research study to evaluate sonar performance using the acoustic array testbed. *FY 2009 Plans:* - Continue 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. - Continue design and development of underwater projectors using structural magnetostrictive materials. - Continue development of improved techniques to distinguish submarine echoes from those produced by ocean bottom features. - Continue dipole projector array design and development. - Continue compact low frequency projector developments. - Initiate single crystal and hybrid projector design and development. The above efforts transfer to the new ASW Distributed Search activity in FY 2010. - Continue development of an acoustic/magnetic hybrid sensor. - Continue development of low cost, compact, combined acoustic sensor. - Continue electroactive polymer smart sensor development.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continue development of target classification algorithms that adapt to local shipping noise conditions, thereby reducing false alarm probability. - Continue development of environmentally adaptive target detection and classification algorithms for deep water operating environments. - Initiate research to improve detection of quiet diesel-electric submarines using passive sonar arrays in deep ocean environments. The above efforts transfer to the new ASW Surveillance activity in FY 2010.					
MARINE MAMMALS The goal of this activity is to support: (1) marine mammal research related to understanding impacts of underwater sound (especially sonar) on marine mammal behavior, hearing, physiology, distributions and ecology; (2) development and testing of new technologies for the detection of marine mammals at sea; (3) research on the bio-acoustic properties, use of sound for detection of, and effects of sound on fish and lesser marine organisms; and (4) research on optically important biota in the coastal ocean in support of Naval Mine, Undersea, and Special Warfare (including oceanic bioluminescence and the development and testing of bioluminescence sensors). The marine mammals research conducted in this Program Element (P.E.) represents part of a total effort executed in coordination with complementary research performed in P.E. 0602435N. This Activity has been created specifically to address the work associated with determining and mitigating the effects on the behavior of marine mammals of manmade sound transmitted underwater. The FY 2008 to FY 2009 funding increase is associated with this newly created Activity which was funded from the Battlegroup Anti-Submarine Warfare Activity ($4.3M) and the Wide Area Anti-Submarine Warfare Surveillance Activity ($1.2M). *FY 2009 Plans:* - Complete an accelerated effort for marine mammal detection involving signal processing of surface radar and the use of autonomous vehicles to allow passive acoustic and electromagnetic detection		0.000	5.500	5.145	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
and monitoring of marine mammals off ranges during fleet Anti-Submarine Warfare experimentation exercises and demonstrations when sound is transmitted underwater. This effort transferred to this newly established Activity from the Battlegroup Anti-Submarine Warfare Defense Activity. - Initiate multi-investigator, coordinated field research to test responses of marine mammals (especially beaked whales) to controlled sound exposures. - Initiate development of new technologies for detection and localization of marine mammals, including (but not restricted to) gliders equipped with passive acoustic sensors, radar and thermal imagery. - Initiate research examining hearing sensitivity of marine mammals (including temporary and permanent threshold shifts). - Initiate research efforts examining distributions and abundances of marine mammals relative to prey fields and basic oceanographic parameters. - Initiate development of and evaluate models that predict time- and space-dependent sound fields produced by anthropogenic noise sources and mammal responses to the noise. - Initiate development and testing of multi-frequency acoustic technologies for detection, identification and enumeration of fish. - Initiate research to examine sensitivity of fish to anthropogenic sound. - Initiate research leading to better predictability of bioluminescent and pigment-bearing planktonic organisms. *FY 2010 Plans:* - Continue all FY 2009 efforts, less those noted as completed above. - Initiate research on effects of chronic physiological stress related to acoustic exposure of marine mammals in the wild.				
NEUTRALIZATION Efforts under this R-2 Activity move to the new Undersea Weaponry R-2 Activity in FY10. This activity's purpose is to develop enabling technologies for undersea weapons to counter threat submarines and surface vessels by increasing Probability of Kill and platform survivability. Weapon technology focus areas include: Explosives and Warheads, Guidance and Control (G&C), Multidisciplinary	22.370	16.513	0.000	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Systems Design & Optimization (MSDO) (comprising Simulation Based Design, Silencing, and Propulsion), Power Sources, Supercavitation, and Torpedo Defense (TD). The ultimate goal of this activity is to develop modular and reduced sized undersea weapons based on common technology enablers (where possible), to provide revolutionary capabilities needed to fill Sea Shield Warfighter Capability Gaps, and enable new undersea weapon concepts of operations to rapidly transition to submarine neutralization/ engagement in deep and shallow water under unique payload limitations posed by unmanned platforms, external stowage, and future Naval platforms. The following demonstration FNC projects are included in this activity: 1) the Lightweight Torpedo Technology (LTT) project (transitions to PE 0603747N in FY 2009), and 2) the Compact Rapid Attack Weapon (CRAW) project. The funding decrease from FY 2008 to FY 2009 represents the phased movement of technologies from Applied (6.2) to Advanced (6.3) Research as the technologies mature. The FY 2009 to FY 2010 funding decrease is due to the realignment of the Neutralization activity to the newly established Undersea Weaponry activity in FY 2010. *FY 2008 Accomplishments:* - 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 optimization of undersea weapons system design using MSDO with respect to constraints in cost and performance. - Continued 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). - Continued implementation of MSDO tools in hybrid propulsion and Weapons Silencing systems development. – Continued development of high-speed supercavitating torpedo vehicle control and homing sensor. - Continued to conduct experiments and tests on vehicle control concepts and homing sensors.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued fourth quarter (of the fiscal year) explosive testing for warhead projects. - Continued conduct of computer code refinements and investigation of supercavitating vehicle dynamics and instability. - Continued development of a supercavitating 6.75-inch (or full-scale) vehicle with vehicle control devices and homing sensors. - Continued feasibility investigations (including acoustic element construction) to test the ability of single crystal to operate at high field, high drive, and high duty cycle for both torpedo Tonpiltz transducer and broadband cylindrical projector applications. - Continued fin and cavitator control, and integrate with controller for the supercavitating 6.75-inch vehicle. - Continued torpedo design and optimization to support the external weapon stowage effort in DARPA Tango Bravo Program. - Continued data collection on a technology test-bed for surface ship close in torpedo defensive system using supercavitating projectiles. - Continued efforts in electric propulsion for the Next Generation Torpedo. - Continued signal processing and homing algorithms for supercavitating vehicle. - Continued efforts that enhance undersea weapons G&C capabilities in autonomy, sensors, sensor processing, communication and networking by leveraging current, or contribute to developing, technologies for UUVs. - Continued weaponization study for unmanned undersea vehicle initiated in FY 2007. - Completed validation of computational models for torpedo lethality and transition to NAVSEA/PMS415. - Initiated test and evaluation of signal processing and homing algorithms for supercavitating vehicle. - Initiated integration of hydroreactive shaped charge technology into CRAW warhead development. (Technology transitioning from PE 0602123N) - Initiated long pulse concept to exploit explosion bubble technology to enhance undersea warhead performance with smaller volumetric requirements. - Initiated efforts to develop air and underwater delivered kinetic energy enhanced lethality warhead concepts. - Initiated hybrid propulsion for Heavyweight Torpedo. - Initiated weaponization study for unmanned surface vehicle.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
The following efforts support the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area: - Continued application of MSDO tools probabilistic methods and uncertainty analysis for LWT design. - Continued development of enhanced performance for torpedo warheads through the use of focused energy technologies for Light Weight Torpedo (LWT) Improvement and CRAW applications. - Continued development of a reduced size/weight CRAW for air deployment. This effort included sensor, guidance and control, warhead, propulsion, and air frame integration tasks. - Continued technology to enable a CRAW warhead to achieve required lethality against submarine targets. - Continued use of design techniques for LWT using undersea weapons system design tools transitioned from Discovery and Innovation to FNC. - Continued development of a shaped charge liner for CRAW warhead initiated in FY 2007. - Continued an iterative algorithm development to enable the CRAW to search, home, and terminally home against targets in deep and shallow water both without and with countermeasures. - Initiated LTT development of an underwater acoustics communications capability to enable coordinated attack and net-centric connectivity. (Transitions to PE 0603747N in FY 2009) - Initiated LTT development of salvo weapons tactics utilizing behavior-based control. (Transitions to PE 0603747N in FY 2009) *FY 2009 Plans:* - Continue all efforts of FY 2008 less those noted as completed above. - Complete transition of appropriate supercavitating vehicle control technology and devices to DARPA Underwater Express Program. - Complete efforts in electric propulsion for LWT. - Complete signal processing and homing algorithms for supercavitating vehicle. - Complete the evaluation of the integration of hydroreactive shaped charge technology into CRAW warhead development. - Complete weaponization study for unmanned undersea vehicle. - Initiate development of advanced undersea warhead fuzing concepts.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate quiet propulsion systems development for torpedoes. - Initiate and complete development of enhanced yield explosive concepts for undersea warhead applications. The following efforts support the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area: - Continue all efforts of FY 2008.					
UNDERSEA WEAPONRY This is a new R-2 Activity starting in FY10. Efforts in this R-2 Activity were funded in the Neutralization R-2 Activity prior to FY10. Undersea Weaponry focuses on the development of enabling technologies to counter threat submarines and surface vessels by increasing Probability of Kill and platform survivability. Weapon technology focus areas include: Explosives and Warheads, Guidance and Control (G&C), Multidisciplinary Systems Design & Optimization (MSDO) (comprising Simulation Based Design, Silencing, and Propulsion), Power Sources, Supercavitation, and Counter Weapons/Counter Measures. The ultimate goal of this activity is to provide revolutionary capabilities needed to fill Sea Shield Warfighter Capability Gaps, to accommodate unique payload limitations through the development of modular and reduced sized undersea weapons based on common technology enablers (where possible), and to provide improved submarine wide area search/cuing in deep and shallow water ocean environments while providing the capability to rapidly adapt the submarine mission to engagement/neutralization. The FY 2009 to FY 2010 funding increase is due to the realignment from the Neutralization activity to this newly established Undersea Weaponry activity in FY 2010. *FY 2010 Plans:* – Complete evaluation of alternative undersea warhead fuzing concept developed under the advanced undersea warhead fuzing initiative.		0.000	0.000	14.766	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete weaponization study for unmanned surface vehicle. - Complete assessment of the kinetic energy warhead concept potential to provide enhanced undersea warhead performance. - Complete transition of the Torpedo Intelligent Controller to NAVSEA/PMS 404 (for heavyweight torpedoes, PE 0205632N) The following efforts support the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area: - Continue 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. - Continue the development of algorithms for CRAW to search, home and terminally home in deep and shallow water against targets both without and with countermeasures. - Continue the development of a CRAW warhead that will achieve required performance against submarine targets, and demonstrate feasibility of achieving final goal. - Complete development of enhanced performance concept for torpedo warheads using focused energy technologies for Light Weight Torpedo (LWT) Improvement and CRAW applications.				
WIDE AREA ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE 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. The decrease from FY 2008 to FY 2009 is due to zero-sum realignment within the Future Naval Capability program of record to fund Navy approved Enabling Capabilities. Additionally, FY 2009 funds were moved to the newly established Marine Mammals Activity ($1.2M). The FY 2009 to FY 2010 funding decrease	29.055	26.521	0.000	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
is due to the realignment of this activity to the newly established ASW Distributed Search, Performance Assessment, Precision Localization and Surveillance activities in FY 2010. *FY 2008 Accomplishments:* - 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. - Continued development of a non-traditional tracking system for deployment on undersea vehicles. - Continued testing of a non-traditional tracking system. - Continued development of alternative active optical sources and sensor devices for Non-Acoustic ASW systems. - Continued an effort to extend the technology base for blue laser sources for Undersea Warfare applications including underwater communications. - Continued an effort to extend the technology base for high performance electro-optic detectors suitable for Undersea Warfare applications including underwater communications. - Continued an effort to extend the technology base for high performance electro-optic filters suitable for Undersea Warfare applications including underwater communications. - Continued an effort to develop consistent and comprehensive modeling and simulation tools for photonic Undersea Warfare and underwater communications components and systems. - Continued an effort to develop optical signal processing technology appropriate for Undersea Warfare and underwater communications systems. - Continued and completed third geomagnetic noise coherence investigation from cooperating airborne measurement platforms. - Continued the development of technologies for a low source-level, light-weight ship-protection system against underwater intruders, including vessels with explosives. - Continued development of signal processing algorithms for operational and pipeline ASW active sonar systems by extending Navy’s broadband, beam-based theory for the Time Reversal Operator.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Completed development of tracking and classification algorithms for broadband Doppler sensitive waveforms for wide area surveillance. - Completed magnetic mapping and localization study and component development for small-diameter Autonomous Undersea Vehicles. - Initiated design of a "Sea Star" undersea local area network to link peripheral sensors to a centralized node through high-bandwidth, short-haul acoustic communications. - Initiated development of spin-dependent tunneling and coupled magnetostrictive/piezoelctric passive magnetometer device technologies. - Initiated development of new acoustic and magnetic sensors for autonomous, networked underwater threat monitoring over large spatial scales. - Initiated development of models that accurately characterize short and long range forward scattering from the ocean boundaries for surveillance through tactical sonar frequencies. - Initiated fiber optic technology development to support the next generation of submarine hull arrays including new transducers, optical multiplexing, and optical components. The following efforts contribute to the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area: - Continued an applied research effort to improve distributed system processing techniques and capabilities. - Continued development of automatic signal processing algorithms for use with a Deep Water Active Deployable System (DWADS) for surveillance of deep ocean submarine threats. - Continued development of a transmit/receive array for use with a DWADS for surveillance of deep ocean submarine threats. - Completed Submarine Track and Trail applied research efforts for UUV technology in the areas of advanced undersea sensors, communications, and autonomy. - Completed experimental test planning for Palantir sensor. - Initiated incorporation and enhancement of technology from real-time data fusion technologies into Distributed System Processing (DSP).				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated and completed a FY 2008 Palantir data collection exercise. All Palantir system related products developed in this PE transition to PE 0603747N where Palantir system development continues. - Initiated development of algorithms to optimize the placement of uncontrolled drifting systems. - Initiated development of a simulator for placement of uncontrolled drifting systems. - Initiated development of technologies to provide rapid localization of threat submarines for On-Demand Detection, Classification and Localization (On-Demand DCL). *FY 2009 Plans:* - Continue development of signal processing algorithms aimed at reducing clutter-generated false alerts. - Continue development/improvement of multi-static signal processing techniques for systems employing coherent sound sources. - Continue development of “intelligent” algorithms aimed at optimizing distributed multistatic sources/ receivers. - Initiate a research effort to accomplish array shape estimation using fiber-optic interferometric methods. - Initiate a collaborative follow-on Joint Research Project for Next Generation Autonomous Sensing (NGAS). The above efforts transfer to the new ASW Distributed Search activity in FY 2010. - Continue development of a non-traditional tracking system for deployment on undersea vehicles. - Continue testing of a non-traditional tracking system. - Continue development of alternative active optical sources and sensor devices for Non-Acoustic ASW systems. - Continue an effort to extend the technology base for blue laser sources for Undersea Warfare applications including underwater communications. - Continue an effort to extend the technology base for high performance electro-optic detectors suitable for Undersea Warfare applications including underwater communications. - Continue an effort to extend the technology base for high performance electro-optic filters suitable for Undersea Warfare applications including underwater communications. - Continue an effort to develop consistent and comprehensive modeling and simulation tools for photonic Undersea Warfare and underwater communications components and systems.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continue an effort to develop optical signal processing technology appropriate for Undersea Warfare and underwater communications systems. - Continue development of spin-dependent tunneling and coupled magnetostrictive/piezoelctric passive magnetometer device technologies. The above efforts transfer to the new ASW Precision Localization activity in FY 2010. - Continue development of models that accurately characterize short and long range forward scattering from the ocean boundaries for surveillance through tactical sonar frequencies. The above effort transfers to the new ASW Performance Assessment activity in FY 2010. - Continue design of a "Sea Star" undersea local area network to link peripheral sensors to a centralized node through high-bandwidth, short-haul acoustic communications. - Continue development of new acoustic and magnetic sensors for autonomous, networked underwater threat monitoring over large spatial scales. - Continue fiber optic technology development to support the next generation of submarine hull arrays including new transducers, optical multiplexing, and optical components. - Complete development of technologies for a low source-level, light-weight ship-protection system against underwater intruders, including vessels with explosives. - Complete development of signal processing algorithms for operational and pipeline ASW active sonar systems by extending Navy's broadband, beam-based theory for the Time Reversal Operator. The above efforts transfer to the new ASW Surveillance activity in FY 2010. The following efforts contribute to the Sea Shield FNC in the Littoral Anti-Submarine Warfare Mission Area: - Continue an applied research effort to improve distributed system processing techniques and capabilities. The above effort transfers to the new ASW Distributed Search activity in FY 2010.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiate research effort aimed at the ideal placement and control of acoustic sources and drifting sensor systems. - Initiate a research effort focusing on distributed system in-situational environmental characterization and system monitoring. - Initiate a research effort to determine the placement of and follow-on control and pattern keeping of mobile sources and distributed sensor systems. The above efforts transfer to the new ASW Performance Assessment activity in FY 2010. - Continue development of algorithms to optimize the placement of uncontrolled drifting systems. - Continue development of a simulator for placement of uncontrolled drifting systems. - Initiate algorithm testing of uncontrolled drifting systems using a simulator. The above efforts transfer to and continue in PE 0603747N under the new ASW Performance Assessment activity in FY 2010. - Continue development of technologies to provide rapid localization of threat submarines for On-Demand Detection, Classification and Localization (On-Demand DCL). The above effort transfers to the new ASW Surveillance activity in FY 2010. - Complete incorporation and enhancement of technology from real-time data fusion technologies into Distributed System Processing (DSP). The above effort completes; it does not transfer or continue in FY 2010. - Complete development of automatic signal processing algorithms for use with a DWADS for surveillance of deep ocean submarine threats. - Complete development of a transmit/receive array for use with DWADS for surveillance of deep ocean submarine threats. The above efforts complete, and the project transitions to PE 0603561N in FY 2010.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602114N/Power Projection Applied Research									Continuing	Continuing
PE 0602123N/Force Protection Applied Research									Continuing	Continuing
PE 0602435N/Ocean Warfighting Environment Applied Research									Continuing	Continuing
PE 0602702E/Tactical Technology									Continuing	Continuing
PE 0602782N/Mine and Expeditionary Warfare Applied Research									Continuing	Continuing
PE 0603114N/Power Projection Advanced Technology									Continuing	Continuing
PE 0603123N/Force Protection Advanced Technology									Continuing	Continuing
PE 0603506N/Surface Ship Torpedo Defense									Continuing	Continuing
PE 0603553N/Surface ASW									Continuing	Continuing
									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602747N UNDERSEA WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

PE 0603561N/Advanced Submarine System Development		
PE 0603739E/Advanced Electronics Technologies	Continuing	Continuing
PE 0603747N/Undersea Warfare Advanced Technology	Continuing	Continuing
PE 0603758N/Navy Warfighting Experiments and Demonstrations	Continuing	Continuing
PE 0604221N/P-3 Modernization Program	Continuing	Continuing
PE 0604261N/Acoustic Search Sensors	Continuing	Continuing
PE 0604784N/Distributed Surveillance System	Continuing	Continuing

D. Acquisition Strategy

N/A

E. Performance Metrics

The overall metrics of applied research in undersea warfare are to develop technologies aimed at improving target detection, classification, localization, tracking, increasing attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments, countering enemy torpedoes, providing the ability to conduct long-range engagements, increasing weapons load-out, providing multi-platform connectivity, increasing endurance/survivability, and reducing size and power requirements.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research					R-1 ITEM NOMENCLATURE PE 0602782N MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	69.831	54.689	40.880						Continuing	Continuing
0000: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH	69.831	54.689	40.880						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE provides technologies for Naval Mine Countermeasures (MCM), Expeditionary Warfare, U.S. Naval sea mining, Naval Special Warfare (NSW), and Joint Tri-Service Explosive Ordnance Disposal (EOD). This program 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 MCM-related and Urban Asymmetric/Expeditionary Warfare Operations (UAEO)-related Future Naval Capabilities (FNC) Enabling Capabilities (ECs). The Mine and Obstacle Detection/Neutralization efforts include technologies for clandestine and overt minefield reconnaissance, organic ship self-protection, organic minehunting and neutralization/breaching. The Urban Asymmetric Operation effort includes critical warfighting functions such as Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), fires, maneuver, sustainment, etc. The Naval Special Warfare and Explosive Ordnance Disposal technology efforts concentrate on the development of technologies for safe near-shore mine detection, diver mobility and survivability, and ordnance disposal operations.

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

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	**R-1 ITEM NOMENCLATURE** PE 0602782N MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	70.504	47.869	45.234	
Current BES/President's Budget	69.831	54.689	40.880	
Total Adjustments	-0.673	6.820	-4.354	
Congressional Program Reductions		-0.152		
Congressional Rescissions				
Total Congressional Increases		7.000		
Total Reprogrammings	-0.099			
SBIR/STTR Transfer	-0.574			
Program Adjustments			-4.402	
Rate/Misc Adjustments		-0.028	0.048	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **AUTONOMOUS UNDERWATER VEHICLE (AUV) DOCKING AND RECHARGING STATION**	2.722	0.000
Project: 9999, **DETECTION AND NEUTRALIZATION OF ELECTRONICALLY INITIATED IMPROVED EXPLOSIVE DEVICES (IEDS)**	2.316	1.995
Project: 9999, **ELECTROMAGNETIC SIGNATURE ASSESSMENT SYSTEM USING MULTIPLE AUTONOMOUS UNDERWATER VEHICLES**	1.929	1.596
Project: 9999, **NAVY SPECIAL WARFARE (NSW) UNATTENDED SENSOR NETWORK**	1.543	0.000
Project: 9999, **REMOTE CONTROLLED SURVEILLANCE SONAR SYSTEM (RCSSS)**	0.966	0.000
Project: 9999, **VIRTUAL ONBOARD ANALYST (VIRONA) FOR MULTI-SENSOR MINE DETECTION**	0.966	0.997
Project: 9999, **WATER SECURITY PROGRAM (INLAND WATER QUALITY AND DESALINATION)**	0.773	2.393

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research				R-1 ITEM NOMENCLATURE PE 0602782N MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH					PROJECT NUMBER 0000	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
0000: MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH	69.831	54.689	40.880						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project focuses on reducing the time involved in conducting MCM operations and increasing safe standoff from minefields. It develops and transitions technologies for MCM-related and UAEO-related FNC ECs. The MCM effort includes technologies for clandestine and overt minefield reconnaissance, organic ship self-protection, organic minehunting, neutralization/breaching and clearance. The Littoral Warfare effort includes critical warfighting functions such as 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 to enhance diver capabilities including: safe near-shore mine sensing, mobility and survivability, and ordnance disposal operations.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MINE TECHNOLOGY	0.196	0.193	0.288	

This activity assesses advanced sea mine technologies to maintain expertise in this Naval Warfare area. An acoustic sensing capability for the naval mine Target Detection Device (TDD) is being addressed. Future mine and minefield concepts are being addressed.

FY 2008 Accomplishments:
- Continued assessment of sea mine technologies in order to maintain a level of expertise in naval mines.

FY 2009 Plans:
- Continue all efforts of FY 2008.
- Initiate evaluation of an acoustic sensing capability for the naval mine Target Detection Device (TDD).

FY 2010 Plans:
- Continue all efforts of FY 2009.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602782N MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate development of concepts for semi-autonomous and remote controlled mines and minefields.					
MINE/OBSTACLE DETECTION 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. It supports Discovery and Invention (D&I) and MCM-related FNC ECs. Efforts in Synthetic Aperture Sonar (SAS) technologies for longer range detection and classification of mine-like targets and magnetic gradiometer sensing and electro-optic (EO) technology for buried mine identification, and sensor integration onto Autonomous Underwater Vehicles (AUVs) are being addressed. EO 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. Efforts also support development of MCM Mission Modules for Littoral Combat Ships (LCS). The decrease from FY 2008 to FY 2009 reflects a reduced level of investment to support other Navy priorities. *FY 2008 Accomplishments:* - Continued at-sea testing of prototype Low Frequency Broadband (LFBB) acoustic scattering sonar focusing on multi-aspect mine classification/identification and characterization of clutter in various environments. - Continued development of automatic mine detection and classification algorithms for integrated forward-looking iPUMA sonar and side-looking sonars. - Continued development of data fusion algorithms for underwater EO, magnetic and acoustic sensors to enhance probability of classification and probability of identification and reduce false alarm rate for proud and buried mine hunting. - Continued 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 Mine Warfare Environmental Data Library (MEDAL) for improved mine detection and avoidance.		42.238	32.585	29.533	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602782N MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued development of UUV-based extended range electro-optic identification sensors and supporting meteorology and oceanography and planning systems. - Continued evaluation of Littoral Remote Sensing (LRS) algorithm development requirements utilizing data streams available from national and organic sensors. - Continued large area search and survey based upon multiple, cooperating UUVs. - Continued model prediction verification for acoustic interactions with ocean bottoms containing configurations of inclusions, multiple scattering from clusters, rough surface shadowing effects and layers to improve model performance in buried mine identification. - Continued phenomenology studies for improved mine detection algorithms for UAV sensors. - Continued technology development for a Tactical UAV (TUAV) buried minefield detection sensor. - Continued technology development for MCM Mission Module systems for Advanced Flight LCS. - Continued the development of a numerical simulation capability for exploring SAS system sensitivities to seafloor sediment parameters. - Continued the development of multi-static acoustic sensing and processing for cooperating, unmanned vehicles. - Completed design and development of Broadband interferometric SAS - and complete at-sea testing. - Completed development of long range, forward-looking iPUMA sonar for small (12.75”) UUVs and begin at-sea testing. - Completed development of UWB SAR imaging algorithms and design, and construction of SAR breadboard experimental system. - Completed the development of a low-cost, 12.75” UUV-based EO sensor for mine identification and conduct initial sea testing of sensor performance. - Completed the primary sub-system design efforts to extend mine identification using acoustic color concept to longer ranges. - Initiated demonstration of flapping fin propulsion on an inexpensive, stealthy undersea vehicle to enable new mine warfare mission capabilities. - Initiated development of algorithms exploiting broadband acoustic transmit waveforms for improved automatic classification of buried mines from clutter. - Initiated development of an ultrafast silicon carbide (SiC) avalanche transistor and a SiC drift step recovery diode.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602782N MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated development of Multiple Input Multiple Output (MIMO) UUV communications by determining channel capacity and extending use to moving platforms. - Initiated integration of iPUMA and SAS systems in a single vehicle to obtain 100% area coverage. - Transitioned revolutionary low frequency broadband mine hunting technology to PMS-403. *FY 2009 Plans:* - Continue all efforts of FY 2008 less those noted as completed above. - Complete development of algorithms exploiting broadband acoustic transmit waveforms for improved automatic classification of buried mines from clutter. - Complete development of data fusion algorithms for underwater electro-optic, magnetic and acoustic sensors to enhance probability of classification (Pc) and probability of identification (Pid) and reduce false alarm rate for proud and buried mine hunting. - Complete evaluation of LRS algorithm development requirements utilizing data streams available from national and organic sensors. - Complete model prediction verification for acoustic interactions with ocean bottoms containing configurations of inclusions, multiple scattering from clusters, rough surface shadowing effects and layers to improve model performance in buried mine identification. - Complete phenomenology studies for improved mine detection algorithms for UAV sensors. - Complete the development of a numerical simulation capability for exploring SAS system sensitivities to seafloor sediment parameters. - Complete the development of multi-static acoustic sensing and processing for cooperating, unmanned vehicles. - Initiate development of a Mine/Obstacle Detection and Avoidance capability for Autonomous Underwater Vehicles (AUVs) equipped with the iPUMA sonar system. - Initiate development of a small ultrasound acoustic underwater camera for UUV-based classification and identification of underwater mines. - Initiate development of advanced 3-D LIDAR mine detection algorithms to support post mission analysis. - Initiate development of drifting mine detection concepts.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602782N MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate development of heat engine for unmanned underwater vehicles powered by thermal gradients in the water column. - Initiate development of Performance Analysis and Training Tool (PATT) to assess the performance characteristics of high frequency imaging sonars and the associated sonar processing concepts. - Initiate investigation of Finite Element Modeling (FEM) for estimating the performance of the Low Frequency Broadband (LFBB) Buried Mine Identification System over a wide range of tactically important environments. - Initiate modeling of data fusion and mine contact handling. - Initiate research to demonstrate new structural-acoustic-based mine identification algorithms that do not require extensive training data to work in new underwater environments. - Initiate research to extend electro-optical imaging resolution in underwater environments by using short exposure techniques. - Investigate and develop signal processing algorithms in areas of research such as environmentally adaptive channel estimation/equalization, multi-carrier modulation techniques, and spatial diversity exploitation to enable reliable, high-rate communication between fixed and/or mobile nodes in an ad hoc underwater acoustic communication network. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. - Complete technology development for a Tactical UAV (TUAV) buried minefield detection sensor. - Complete development of advanced 3-D LIDAR mine detection algorithms to support post mission analysis. - Complete development of the Performance Analysis and Training Tool (PATT) to assess the performance characteristics of high frequency imaging sonars and the associated sonar processing concepts. - Complete investigation of Finite Element Modeling (FEM) for estimating the performance of the Low Frequency Broadband (LFBB) Buried Mine Identification System over a wide range of tactically important environments. - Complete technology development for MCM Mission Module systems for Advanced Flight LCS.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602782N MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate development of iPUMA/Synthetic Aperture Sonar system to provide the first non marine mammal based mine detection and classification capability for confined or highly obstructed areas. - Initiate development of Small Acoustic Color/Imaging Sonar system to provide the first non marine mammal detection, classification and identification capability for very shallow water (VSW) and reduce the false-alarm rate by x20 for all VSW mine threats. - Initiate development of Long Range Low Frequency Broadband (LRLFBB) Sonar to significantly increase the minehunting area coverage rate. - Initiate development of a high source level, single crystal based projector that can extend the maximum detection range of the Low Frequency Broadband (LFBB) Mine Identification System. - Initiate Phase 2 of Advanced Mission Module Technology Development. - Initiate performance evaluation of physical layer signal processing algorithms and signaling schemes developed for underwater acoustic communication networks. - Initiate implementation of candidate physical layer algorithms and signaling schemes into acoustic modems targeted for UUV platforms. - Initiate investigation into cross-layer and/or network layer design strategies for ad hoc underwater acoustic communication networks comprised of fixed and/or mobile nodes. - Initiate development of technologies for detection of mines and obstacles in riverine environments. - Initiate development of mine burial prediction models which include migrating sandwaves. - Initiate development of prediction models for surf zone optical properties. - Initiate effort to quantify and validate improvements in probability of detection and the reduction of false alarms that can be achieved through multi-static acoustic sensing and processing for cooperating, unmanned vehicles. - Initiate development of new waveforms and algorithms for improved automatic discrimination of mines from non-traditional clutter.					
MINE/OBSTACLE NEUTRALIZATION Activity includes applied research to support selected MCM related FNC ECs 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, models and assessments to support the various far-term Surf Zone (SZ) and Beach Zone (BZ) mine and obstacle breaching concepts.		5.714	4.363	1.308	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602782N MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY 2009, funding programmed for new FNC ECs was realigned to reflect the priorities of the Navy. The investment reduction from FY 2009 through FY 2010 reflects the completion and transfer of many major projects by the end of FY 2009 and 2010. *FY 2008 Accomplishments:* - Continued development of models to assess performance of bombs against mines in Very Shallow Water (VSW). - Continued development of advanced computational models for high speed water entry and penetration. - Continued development of advanced computational tools for predicting soil penetration by countermine darts. - Continued technology development for autonomous neutralization of sea mines in VSW areas. - Continued development of stand-off, assault breaching warhead fuse to extend effectiveness of unitary warheads to greater water depths. - Continued development of precision navigation capability for targeting, safe navigation through assault lanes including lane marking. - Initiated development of AUV technologies for neutralization of littoral sea mines. - Initiated acoustic organic mine jamming investigations as a follow-on to FNC work in electromagnetic organic mine jamming. *FY 2009 Plans:* - Continue all efforts of FY 2008. - Complete development of models to assess performance of bombs against mines in VSW. - Complete development of advanced computational models for high speed water entry and penetration. - Complete development of advanced computational tools for predicting soil penetration by countermine darts. - Complete assessment of stand-off, assault breaching warhead fuse to extend effectiveness of unitary warheads to greater water depths.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602782N MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH			PROJECT NUMBER 0000	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate development of prototype mission planner for JDAM Assault Breaching System (JABS) in the VSW. - Initiate review of GPS augmentation data collected during end-to-end tests with Amphibious Assault Vehicle (AAV) and airborne platform with mine detection sensor. - Initiate review of data collected during AAV testing with augmented reality. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. - Complete acoustic organic mine jamming investigations as a follow-on to FNC work in electromagnetic organic mine jamming. - Complete development of precision navigation capability for targeting, safe navigation through assault lanes including lane marking. - Complete development of prototype mission planner for JABS in the VSW. - Complete review of data collected during AAV testing with augmented reality. - Complete review of GPS augmentation data collected during end-to-end tests with AAV and airborne platform with mine detection sensor. - Complete technology development for autonomous neutralization of sea mines in VSW areas. - Initiate development of concepts for sweeping and/or jamming of advanced mine threats. - Initiate a project to study feasibility of mine jamming from autonomous undersea vehicles. - Initiate development of autonomous behaviors to improve neutralization efficiency of littoral sea mines. - Initiate development of system concepts for autonomous neutralization of surface and submerged drifting mines.					
SPECIAL WARFARE/EOD The goal of this effort is to develop technologies to extend stand-off of special operations and EOD forces in clandestine hydrography, mine clearance and port security missions while increasing the range and effectiveness of divers. Advanced technologies are needed to gain access to areas contaminated by area-denial sensors and/or booby traps. Developed 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		10.468	10.567	9.751	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602782N MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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 2008 Accomplishments:* - Continued assessment of x-ray fluorescence technologies for the detection of bulk explosive compounds in containers and vehicles. - Continued development of AUV technologies for autonomous inspection of ship hulls. - Continued development of buried ordnance identification sensor. - Continued development of dual-mode visible sensor for clandestine tracking of near-shore craft and other objects. - Continued development of low probability of intercept/low probability of detection (LPI/LPD) underwater communications. - Continued development of metal-hydride based thermal control technology for combat divers. - Continued development of technology to detect, monitor, and disrupt operation of Explosive Safe and Arming (ESA) devices. - Completed development of a Seal Delivery Vehicle (SDV) low-observable periscope. - Completed development of robotic manipulators, actuators and control algorithms based on artificial muscle materials. - Initiated design of an underwater riverine autonomous surveillance system that uses multiple small sensor nodes to provide persistent surveillance. - Initiated development of tactile-feedback robotic manipulators. - Initiated development of technologies for portable hand-held detection of concealed Improvised Explosive Devices (IEDs). *FY 2009 Plans:* - Continue all efforts of FY 2008 less those noted as completed above. - Complete development of dual-mode visible sensor for clandestine tracking of near-shore craft and other objects. - Complete development of buried ordnance identification sensor.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602782N MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete assessment of x-ray fluorescence technologies for the detection of bulk explosive compounds in containers and vehicles. - Initiate development of low collateral damage neutralization device. - Initiate development of technologies for the detection and disruption of passive and active IR sensors. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. - Complete design of an underwater riverine autonomous surveillance system that uses multiple small sensor nodes to provide persistent surveillance. - Complete development of low probability of intercept/low probability of detection (LPI/LPD) underwater communications - Complete development of metal-hydride based thermal control technology for combat divers. - Complete development of tactile-feedback robotic manipulators. - Complete development of technologies for portable hand-held detection of concealed Improvised Explosive Devices (IEDs). - Complete development of technology to detect, monitor, and disrupt operation of Explosive Safe and Arming (ESA) devices. - Initiate development of maritime TTL technologies. - Initiate development of technologies for contaminated water diving. - Initiate development of technologies for enhanced navigation and ISR in riverine environments. -Initiate development of technologies to detect and locate IEDs.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602782N MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602131M/Marine Corps Landing Force Technology									Continuing	Continuing
PE 0602435N/Ocean Warfighting Environment Applied Research									Continuing	Continuing
PE 0602712A/ Countermine Systems									Continuing	Continuing
PE 0603502N/Surface and Shallow Water Mine Countermeasures									Continuing	Continuing
PE 0603606A/Landmine Warfare and Barrier Advanced Technology									Continuing	Continuing
PE 0603640M/USMC Advanced Technology Demonstration (ATD)									Continuing	Continuing
PE 0603654N/Joint Service Explosive Ordnance Development									Continuing	Continuing
PE 0603782N/Mine and Expeditionary Warfare Advanced Technology									Continuing	Continuing
PE 0604654N/Joint Service Explosive Ordnance Development									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 02 - Applied Research	R-1 ITEM NOMENCLATURE PE 0602782N MINE AND EXPEDITIONARY WARFARE APPLIED RESEARCH	PROJECT NUMBER 0000

PE 1160401BB/Special Operations Technology Development	Continuing	Continuing
PE 1160402BB/Special Operations Advanced Technology Development	Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

The overall metrics of this applied research program are the development of technologies which focus on the Expeditionary Warfare challenge of speeding the tactical timeline and increasing safe standoff from minefields. Individual project metrics include the transition of 6.2 technology solutions into 6.3 advanced technology programs.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603114N POWER PROJECTION ADVANCED TECHNOLOGY					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	94.020	81.675	107.969						Continuing	Continuing
2911: POWER PROJECTION ADVANCED TECHNOLOGY	57.943	59.934	107.969						Continuing	Continuing
9999: CONGRESSIONAL PLUS-UPS	36.077	21.741	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This program develops and demonstrates advanced technologies, including Directed Energy, for naval weapon systems, and the Electric Warship. This Program Element (PE) includes elements of the following Future Naval Capabilities (FNCs); Time Critical Strike, and ForceNet. 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.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603114N POWER PROJECTION ADVANCED TECHNOLOGY

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	85.977	60.360	70.519	
Current BES/President's Budget	94.020	81.675	107.969	
Total Adjustments	8.043	21.315	37.450	
Congressional Program Reductions		-0.253		
Congressional Rescissions				
Total Congressional Increases		21.800		
Total Reprogrammings	9.250			
SBIR/STTR Transfer	-1.207			
Program Adjustments			37.381	
Rate/Misc Adjustments		-0.232	0.069	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **ADVANCED MOTOR-PROPULSOR DEVELOPMENT AND TESTING**	3.859	0.000
Project: 9999, **ADVANCED SHIP SELF DEFENSE TECHNOLOGY TESTING**	0.000	3.989
Project: 9999, **COUNTERMINE LIDAR UAV-BASED SYSTEM**	0.000	1.197
Project: 9999, **DETECTION, TRACKING, AND IDENTIFICATION FOR ISRTE OF MOBILE AND ASYMMETRIC TARGETS**	0.965	1.596
Project: 9999, **EXCALIBUR**	0.771	0.000
Project: 9999, **EXPEDITIONARY CRAFT**	19.322	0.000
Project: 9999, **FLOW PATH ANALYSIS TOOL (FPAT)**	0.971	0.000
Project: 9999, **HIGH SPEED ANTI-RADIATION DEMONSTRATION (HSAD)**	1.569	0.798
Project: 9999, **LONG WAVELENGTH ARRAY**	2.336	2.792
Project: 9999, **QUIET DRIVE ADVANCED ROTARY ACTUATOR**	0.000	1.995
Project: 9999, **REALTIME HYPERSPECTRAL TARGETING SENSOR**	0.000	2.394
Project: 9999, **SMART INSTRUMENT DEVELOPMENT FOR MAGDALENA RIDGE OBSERVATORY (MRO)**	6.284	6.980

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603114N POWER PROJECTION ADVANCED TECHNOLOGY

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603114N POWER PROJECTION ADVANCED TECHNOLOGY					PROJECT NUMBER 2911	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
2911: POWER PROJECTION ADVANCED TECHNOLOGY	57.943	59.934	107.969						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports the Time Critical Strike (TCS) and ForceNet FNC components which address technological issues associated with the development of strike weapons to significantly decrease the launch to engagement timeline; provide the Navy of the future the ability to quickly locate, target, and strike critical targets; and enhance mission capabilities and operational utility of Naval forces by dramatically increasing the autonomy, performance, and affordability of Naval organic Unmanned Vehicle systems.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
PRECISION STRIKE TECHNOLOGY	32.105	27.532	92.744	

This activity focuses on the development of high speed (Mach 3 to Mach 4+) strike technologies which significantly decrease the engagement timeline from multiple sea surface and air launched platforms.

The increase in funding between FY 2009 and FY 2010 is due to the significant increase in the 6.3 demonstration portion of the Electromagnetic (EM) Railgun Program and also is due to a cooperative Navy/DARPA Program for the Long Range Anti-Ship Missile (LRASM) Program.

FY 2008 Accomplishments:

RATTLRS:
- Initiated RATTLRS flight tests demonstrating high speed aero-propulsion integration.
- Initiated data reduction of flight demonstrations and prepare final program report.

HyFly:
- Continued conducting final fully powered HyFly flight to demonstrate Hypersonic and long range flight performance.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603114N POWER PROJECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2911

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
EM Gun: - Continued procurement and installation of pulsed power modules for the Electromagnetic Launch Facility (EMLF) at NSWCDD. - Continued development and testing of barrel life components with EM lab launcher below 16 MJ of muzzle energy. - Continued development of industry advanced launcher prototypes including component hardware testing and preliminary design review. - Continued development and initiate testing of projectile component concepts including a unitary lethality demo. - Continued ship integration study efforts. - Continued INP Phase I program mid-way assessment. *FY 2009 Plans:* EM Gun: - Continue development and testing of barrel life components with EM lab launcher expanding to 16 MJ of muzzle energy. - Continue development of industry advanced launcher prototypes, completing the preliminary design review and initiating detail design activities and component hardware testing. - Continue development and testing of projectile component concepts, completing unitary lethality demo and initiating a dispense lethality demo. - Continue ship integration study efforts. - Complete INP Phase I program mid-way assessment. - Complete fabrication and installation of pulsed power modules for the Electromagnetic Launch Facility (EMLF) at NSWCDD. RATTLRS: - Complete RATTLRS flight test demonstration. - Complete data reduction of flight demonstration. Above Threshold Reprogramming (ATR) for RATTLRS ($18.789) was approved March 2009 and transferred from Program Element 0603236N (not reflected in current funding profile).				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603114N POWER PROJECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2911

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2010 Plans: EM Gun: - Continue development and testing of barrel life components with EM lab launcher expanding to 32 MJ of muzzle energy. - Continue development of industry advanced launcher prototypes, completing detail design activities and initiating detail design fabrication. - Continue development and testing of projectile component concepts, completing the dispense lethality demo and initiating 32 MJ muzzle energy tests. - Continue ship integration study efforts. - Initiate planning for FY 2011 final INP Phase I assessment. - Initiate next generation pulsed power concept design. LRASM: - New Start: DARPA initiated effort for development of missile preliminary designs and perform analysis demonstrating designs compliant with program requirements and that subsystem technologies development plans have acceptable risk, schedule and cost. - Initiate detailed hardware design.				
STRIKE AND LITTORAL COMBAT TECHNOLOGIES The focus of this activity is on those technologies that will support the Naval Precision Strike Operations and provide the Navy of the future the ability to quickly locate, target, and strike critical targets. This activity includes support to the following FNC Enabling Capabilities (ECs): Advanced Naval Fires Technology, Hostile Fire Detection and Response, Dynamic Target Engagement & Enhanced Sensor Capabilities, and Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets.	25.838	32.402	15.225	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603114N POWER PROJECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2911

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
The fluctuations in the funding profile from FY 2008 through FY 2010 are a combination of funding additional FNC projects while other FNC projects are completing. This Activity reflects the alignment of investments for the following ECs: Hostile Fire Detection and Response Spiral 2, Dynamic Target Engagement & Enhanced Sensor Capabilities, Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets and Enhanced Weapons Technologies. Increased Capability Against Moving and Stationary Targets, Counter Air Mid-Range Air-to-Air Missile (AMRAAM)/Defense/High Speed Improvements, Multi-Target Laser Designator and Selectable Output Components. *FY 2008 Accomplishments:* Hostile Fire Detection and Response: - Completed Reconfigurable Surveillance UAV for Warfighters which developed EO/IR sensors and foliage penetration radars suitable for high resolution imaging of ground threats through rain, fog, and camouflage from small UAVs. Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets: - Continued Low Cost Imaging Terminal Seeker (LCITS) projects. - Initiated Weapons Data Link (WDL) project to develop a weapons data link terminal that will allow robust in-flight control of strike weapons at greater standoff ranges with reduced power/space/weight requirements, and improved protection against Electronic Counter Measures (ECM). Dynamic Target Engagement & Enhanced Sensor Capabilities: - Continued effort to provide a low-cost, single board radar system suitable for use on a long endurance UAV. - Continued effort to provide affordable, high endurance platform/propulsion with Commercial Off the Shelf (COTS) and modified COTS components for persistent Intelligence, Surveillance and Reconnaissance (ISR), targeting, Bomb Damage Assessment/Bomb Damage Indication (BDA/BDI), and weapon delivery.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603114N POWER PROJECTION ADVANCED TECHNOLOGY			PROJECT NUMBER 2911	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

- Continued development of Electro Optic/Infrared (EO/IR) sensors and foliage penetration radars suitable for high resolution imaging of ground threats through rain, fog, and camouflage from small UAVs.
- Continued Ultra Endurance UAV project.
- Completed GMTI Scout, and Remote Sensor Fusion Card efforts.
- Initiated Decision Support for Dynamic Target Engagement.

Increased Capability Against Moving and Stationary Targets:
- Initiated Direct Attack Seeker Head (DASH) project to use active millimeter wave (mmW) radar and Imaging Infrared (IIR) seekers to develop and demonstrate a low cost multi-sensor array technology to engage moving targets in adverse weather battlefield conditions. The DASH common aperture architecture is applicable to a variety of weapon airframes such as Hellfire, High Speed Anti-Radiation Missile (HARM), Joint Direct Attack Munition (JDAM), and Harpoon.
- Initiated Multi-Mode Sensor/Seeker (MMSS) project to develop a tri-mode sensor/seeker for use on surveillance platforms such as Fire Scout. MMSS will develop and demonstrate the capability to provide increased range target search, acquisition, identification, and tracking in both clear and adverse battlefield weather.

FY 2009 Plans:

Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets:
- Continue WDL hardware and software demonstration of a weapons data link terminal that will allow robust in-flight control of strike weapons at greater standoff ranges with reduced power/space/weight requirements, and improved protection against ECM.
- Complete LCITS project, including captive carry of the weapon integrated seeker and upgraded launcher and firing two guided rounds within a tactically relevant environment.

Dynamic Target Engagement & Enhanced Sensor Capabilities:
- Complete Decision Support for Dynamic Target Engagement, and Ultra Endurance UAV efforts.

Increased Capability Against Moving and Stationary Targets:

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603114N POWER PROJECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2911

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continue the DASH project to drive down seeker cost during the procurement and test of the infrared imaging seeker components. - Continue MMSS project to conduct a Concept Design Review (CDR) and initiate the build of a common aperture Laser Radar (LADAR) and infrared sensor system. Enhanced Weapons Technologies: Maintain development of advanced technologies that support delivery of Navy approved FNC ECs structured to close operational capability gaps in power projection. Package advanced power projection technologies into deliverable FNC products and ECs that can be integrated into acquisition programs within a five year period. Mature power projection technologies that support naval requirements identified within the Sea Strike and FORCEnet naval capability pillars. - Initiate three new products to address short-falls in current Counter Air (CA) and Counter Air Defense (CAD) capabilities by providing improved range and end-game maneuverability while decreasing Time-of-Flight. - Initiate definition and documentation of system level requirements for airframe, thrust level, insensitive-munitions and safety/reliability for CA Advanced Mid-Range Air-to-Air Missile (AMRAAM) Improvements. - Initiate definition and documentation of system level requirements for CAD. - Initiate definition and documentation of system level requirements for High Speed Components. *FY 2010 Plans:* Discriminate and Provide Terminal Guidance for Weapons Targeted at Moving Targets: - Continue Weapon Data Link project by demonstrate the performance capability of the system and the architecture develop under the project. Increased Capability Against Moving and Stationary Targets: - Continue all efforts of FY 2009. - Initiate research for advanced optical techniques to enable multiple simultaneous target designation in order to defeat multiple simultaneous targets or SWARM attacks. Enhanced Weapon Technologies:				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603114N POWER PROJECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2911

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continue all efforts of FY 2009. Selectable Output Weapon: - Initiate Selectable Output Weapon Sea Strike Project. This project will develop and integrate new technologies to enable real-time selection of a munitions energetic output.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603114N POWER PROJECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2911

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0305204N/Tactical Unmanned Aerial Vehicles									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602114N/Power Projection Applied Research									Continuing	Continuing
PE 0602131M/Marine Corps Landing Force Technology									Continuing	Continuing
PE 0602203F/Aerospace Propulsion									Continuing	Continuing
PE 0602236N/Warfighter Sustainment Applied Research									Continuing	Continuing
PE 0603123N/Force Protection Advanced Technology									Continuing	Continuing
PE 0603236N/Warfighter Sustainment Advanced Technology									Continuing	Continuing
PE 0603502N/Surface and Shallow Water Mine Countermeasures									Continuing	Continuing
PE 0603654N/Joint Service Explosive Ordnance Development									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603114N POWER PROJECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2911

PE 0603709D8Z/Joint Robotics Program	Continuing	Continuing
PE 0603782N/Mine and Expeditionary Warfare Advanced Technology	Continuing	Continuing
PE 0603790N/ NATO Research and Development	Continuing	Continuing
PE 0604709D8Z/Joint Robotics Program	Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

The metrics used are programmatic milestones and technical milestones such as flight test and testing of projectile concepts for technical demonstration programs; Technology Transition Agreements (TTAs) which are agreements between the Office of Naval Research and an acquisition program office to transition FNC 6.3 technologies into an acquisition program.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	125.869	113.502	66.035						Continuing	Continuing
2912: FORCE PROTECTION ADVANCED TECHNOLOGY	75.194	52.675	63.695						Continuing	Continuing
3049: FORCE PROTECTION	2.132	2.226	2.340						Continuing	Continuing
9999: CONGRESSIONAL PLUS-UPS	48.543	58.601	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE addresses advanced technology development 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 Sea Shield and Cross Pillar Enablers, and Enterprise and Platform Enablers (EPE). 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.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	119.562	55.099	63.845	
Current BES/President's Budget	125.869	113.502	66.035	
Total Adjustments	6.307	58.403	2.190	
Congressional Program Reductions		-0.316		
Congressional Rescissions				
Total Congressional Increases		58.760		
Total Reprogrammings	8.079			
SBIR/STTR Transfer	-1.772			
Program Adjustments			2.155	
Rate/Misc Adjustments		-0.041	0.035	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **ACCELERATING FUEL CELLS MANUFACTURABILITY AND THEIR APPLICATION IN THE ARMED FORCES**	2.651	2.394
Project: 9999, **ADVANCED CONTINUOUS ACTIVE SONAR FOR UUVS**	0.000	2.492
Project: 9999, **ADVANCED LOGISTICS FUEL REFORMER FOR FUEL CELLS**	2.313	2.394
Project: 9999, **ADVANCED VOLUME SENSOR SYSTEM**	1.548	0.000
Project: 9999, **AGILE PORT AND HIGH SPEED SHIP TECHNOLOGY**	2.314	5.983
Project: 9999, **CENTER FOR APPLIED RESEARCH IN INTELLIGENT AUTONOMOUS SYSTEMS**	0.000	2.394
Project: 9999, **CRYOGENIC POWER SYSTEM FOR UNMANNED UNDERWATER VEHICLES**	0.968	0.000
Project: 9999, **DETECTING IMPROVISED EXPLOSIVE DEVICES (IEDS)**	0.965	0.000
Project: 9999, **DIRECT MOTOR DRIVEN WATERJET**	1.548	0.000
Project: 9999, **DURABILITY, ENERGY SAVING AND SUSTAINABILITY OF OCEANIC VEHICLES AND SUPPORT INFRASTRUCTURE THROUGH USE OF NANOTECH LUBRICANTS**	0.000	0.798
Project: 9999, **ELECTROCHEMICAL FIELD DEPLOYABLE SYSTEM FOR POTABLE WATER GENERATION**	2.316	2.791
Project: 9999, **FUTURE FUEL NON-TACTICAL VEHICLE INITIATIVE**	1.547	1.596

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **HIGH POWER DENSITY MOTOR DRIVE**	0.000	0.997
Project: 9999, **HIGH SPEED POWER NODE SWITCHING AND CONTROL CENTER**	1.549	0.000
Project: 9999, **HIGH TEMPERATURE SUPERCONDUCTOR TRAP FIELD MAGNET MOTOR**	0.000	1.995
Project: 9999, **IMPLEMENTATION OF FORMABLE TEXTILE FOR COMPLEX SHAPED AEROSPACE COMPOSITE STRUCTURES**	1.547	1.596
Project: 9999, **IMPROVED STEALTH AND LOWER COST OPERATIONS FOR SHIPS USING HIGH STRENGTH FLAME RESISTANT LCP REINFORCED NETTING**	0.000	1.596
Project: 9999, **INNOVATIVE METHODS FOR SHIP-BUILDING AFFORDABILITY**	1.543	0.000
Project: 9999, **INTEGRATED ADVANCED COMMUNICATIONS TERMINAL (IACT)**	0.966	0.000
Project: 9999, **INTEGRATED ADVANCED SHIP CONTROL (IASC)**	0.000	1.197
Project: 9999, **INTEGRATED SHIP AND MOTION CONTROL TECHNOLOGY**	0.000	3.430
Project: 9999, **LASER PERIMETER AWARENESS SYSTEM**	1.448	1.496
Project: 9999, **M65 BISMALEIMIDE CARBON FIBER PREPREG**	2.322	1.596
Project: 9999, **MARITIME MOBILE FORCE PROTECTION PROGRAM**	1.544	0.000
Project: 9999, **MOBILE MANUFACTURING AND REPAIR CELL/ENGINEERING EDUCATION OUTREACH PROGRAM**	3.860	2.394
Project: 9999, **MULTI-FUEL COMBUSTOR FOR SHIPBOARD FUEL CELLS**	1.545	1.596
Project: 9999, **PURE HYDROGEN SUPPLY FROM LOGISTICS FUEL**	2.320	0.000
Project: 9999, **REMOTE CONTINUOUS ENERGETIC MATERIAL MANUFACTURING FOR PYROTECHNIC IR DECOYS**	0.000	1.596
Project: 9999, **SECURE INFRASTRUCTURE TECHNOLOGY LABORATORY (SINTEL)**	3.091	0.000
Project: 9999, **SELF HEALING TARGET SYSTEM FOR LASER AND SNIPER RANGES**	0.000	1.596
Project: 9999, **SINGLE GENERATOR OPERATIONS LITHIUM ION BATTERY**	4.847	3.988
Project: 9999, **SOLID STATE DC PROTECTION SYSTEM (SSDCP)**	0.386	1.197
Project: 9999, **STABILIZED LASER DESIGNATION CAPABILITY**	0.000	1.995

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **STRATEGIC/TACTICAL RESOURCE INTEROPERABILITY KINETIC ENVIRONMENT PROGRAM**	0.000	1.117
Project: 9999, **TACTICAL COMPACT OPTICAL INTERROGATOR**	1.544	0.000
Project: 9999, **ULTRA-WIDE COVERAGE VISIBLE NEAR INFRARED SENSOR FOR FORCE PROTECTION**	0.000	1.197
Project: 9999, **UNDERGROUND COORDINATION OF MANAGED MESH-NETWORKS (UCOMM)**	0.773	2.394
Project: 9999, **VIDEO AND WATER MIST TECHNOLOGIES FOR INCIPIENT FIRE DETECTION ON SHIPS**	0.000	3.190
Project: 9999, **WIDE-AREA SENSOR FOR FORCE PROTECTION TARGETING**	1.544	1.596
Project: 9999, **WIDE-BAND GAP SEMICONDUCTOR MATERIALS**	1.544	0.000

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY					PROJECT NUMBER 2912	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
2912: FORCE PROTECTION ADVANCED TECHNOLOGY	75.194	52.675	63.695						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project addresses advanced technology development 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 Sea Shield and Cross Pillar Enablers, and Enterprise and Platform Enablers (EPE) -- Future Naval Capabilities (FNCs). The goals of this project are 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.

This Project reflects the alignment of investments for the following ECs: Total Ship Survivability Damage Tolerance and Recoverability; Over-the-Horizon Missile Defense; Two-Torpedo Salvo Defense; Defense of Harbor and Near-Shore Naval Infrastructure Against Asymmetric Threats; Sea Based Missile Defense of Ships & Littoral Installations; Aircraft Integrated Self-Protection Suites; Hostile Fire Detection and Response Spirals 1 and 2; Four-Torpedo Salvo Defense; Shipboard Force Protection in Port and Restricted Waters - Detection and Classification; and Underwater Total Ship Survivability.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FLEET FORCE PROTECTION AND DEFENSE AGAINST UNDERSEA THREATS	24.782	13.598	19.725	
Fleet Force Protection and Defense against Undersea Threats addresses efforts that 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. 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				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2912

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
individual or multi-spectral [Electro-Optic (EO), IR, radio frequency (RF), 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; Advanced Electronic Sensor Systems for Missile Defense; Hostile Fire Detection and Response Spirals 1 and 2; Defense of Harbor and Near-Shore Naval Infrastructure Against Asymmetric Threats; Four-Torpedo Salvo Defense; and Shipboard Force Protection in Port and Restricted Waters - Detection and Classification. 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 shipboard organizational maintenance. The Anti-Torpedo Torpedo (ATT) provides technologies that enable an ATT to engage threat torpedoes detected by a surface ship towed sensor system. The ultimate goal is to develop technologies to enable a torpedo defense capability, including ship self-defense against salvo torpedo attacks, to fill the FNC Sea Shield Warfighting Capability Gap/Enabling Capability: Platform Defense against Undersea Threats. Ultimately the goal is to deliver an anti-torpedo-torpedo for use in defeating a four-torpedo salvo attack against a surface platform. The decrease from FY 2008 to FY 2009 reflects the completion of FNC Enabling Capabilities Two-Torpedo Salvo Defense, Aircraft Integrated Self-Protection Suites, and Hostile Fire Detection and Response Spiral 2; and decreased efforts in Defense of Harbor and Near-Shore Naval Infrastructure Against Asymmetric Threats. The increase in funding from FY 2009 to FY 2010 is due to the ramping up of the following Future Naval Capability Enabling Capabilities: Shipboard Force Protection in Port and Restricted Waters - Detection and Classification, Four-Torpedo Salvo Defense, Advanced Threat Aircraft Countermeasures, and Helicopter Low-Level Operations (HELO).				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2912

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2008 Accomplishments: Sensors & Associated Processing - - Completed FNC Enabling Capabilities: Two-Torpedo Salvo Defense, Aircraft Integrated Self-Protection Suites, and Hostile Fire Detection and Response Spiral 2. - Completed laboratory demonstration of a coated carbon fiber cable that survives 27 times longer than Zylon under direct flame at temperatures >1800 degrees Fahrenheit. Integrated Defensive Electronic Countermeasures Pre-Planned Product Improvement (IDECM P3I). - Completed laboratory demonstration of the upgraded multiband laser towards a goal of 5W in all bands for EO/IR Jammer for TACAIR. - Completed the End User Terminal (EUT) effort by conducting a side-by-side laboratory demonstration of the Dismounted-Digital Automated Computing Terminal (D-DACT) including the integrated 256 color Organic Light Emitting Diode (OLED) display with a Liquid Crystal Display D-DACT. - Completed the integration of the Gallium Arsenide (GaAs) transmitter with an ALE-55 sized Fiber-Optic Towed Decoy (FOTD) and onboard power supply for the Integrated Defensive Electronic Countermeasures Pre-Planned Product Improvement (IDECM P3I) effort. - Completed the integration of a noncryogenic solid-state Mid-wave Infrared (MWIR) multiband laser into a prototype Tactical Aircraft Directed IR Countermeasures (TADIRCM) pod that will undergo an Early Operational Assessment (EOA) (EO/IR Laser Jammer for TACAIR). - Completed preparations for the completion of the EUT effort by planning a field demonstration of the full capabilities of the integrated personal communications, situational awareness, and gunfire detection system including the Monocular Display with a super video graphics adapter (SVGA) resolution of 800x600 pixels. - Completed the Integrated EO/IR Self Protect Suite for Rotary Wing Aircraft by conducting a field demonstration of the integrated Missile Warning Sensor (MWS) and multi-band fiber coupled laser jammer. - Completed the Intelligent Video Surveillance project including integration of object recognition and tracking algorithms, machine vision, and multiple networked video streams into different classes of EO/IR sensors.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY			PROJECT NUMBER 2912	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Completed the IDECM P3I effort by conducting final flight testing of improved decoys and towlines. - Completed performance evaluation of a Counter Torpedo Detection, Classification and Localization (CTDCL) prototype torpedo protection system capable of countering two torpedoes launched in rapid succession. - Initiated new FNC Enabling Capability (EC) Shipboard Force Protection in Port and Restricted Waters - Detection and Classification. This project will develop mission specific electro-optic/infrared sensors to detect, classify, and determine the intent of potential terrorist and special operations force threats to ships and craft in port and transiting restricted waters. Underwater Platform Self-Defense - - Completed the Underwater Threat Neutralization project including demonstration of a scalable low frequency continuous wave acoustic system for use against underwater asymmetric threats in port. - Initiated the development of low-cost, light-weight swimmer detection and localization technologies. *FY 2009 Plans:* Sensors & Associated Processing - - Continue all efforts of FY 2008, less those noted as completed above. - Continue new FNC EC entitled Shipboard Force Protection in Port and Restricted Waters - Detection and Classification, initiated, in FY 2008. This effort develops mission specific electro-optic/infrared sensors to detect, classify, and determine the intent of potential terrorist and special operations force threats to ships and craft inport and transiting restricted waters. Sensor projects included in this FNC EC include Distributed Millimeter Wave (DmmW) Sensor, Active/Passive Dual Imaging IR (MW/SW) Sensor, and Situational Panoramic Infrared (SPIR) Sensor. - Initiate the Countermeasures for Advanced Imaging Infrared (IIR) Guided Missiles FNC effort by commencing IIR threat surrogate hardware development. - Initiate the Countermeasures for Millimeter Wave Guided Missiles FNC effort by initiating wide band gap monolithic microwave integrated circuit (MMIC) Ka-band development. - Initiate the Multifunction Capabilities for Missile Warning Sensors FNC effort by commencing signal processor development.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY			PROJECT NUMBER 2912	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate the Helicopter Laser-Based Landing Aids FNC effort by commencing laser technologies development. Underwater Platform Self-Defense - - Continue all efforts of FY 2008, less those noted as completed above. - Initiate expanded development of autonomous, underway refueling for Unmanned Sea Surface Vehicle Technologies. - Initiate advanced development of software encoded algorithms for the Anti-Torpedo Torpedo (ATT) sensor and controller that will enable ATT's to successfully engage torpedo salvoes of up to four attacking units. *FY 2010 Plans:* Sensors & Associated Processing – - Continue all efforts of FY 2009. Underwater Platform Self-Defense - - Continue all efforts of FY 2009. - Complete development and demonstration of low-cost, light-weight swimmer detection and localization technologies.					
MISSILE DEFENSE (MD) This activity describes Missile Defense Science and Technology (S&T) projects of the Sea Shield Future Naval Capability (FNC) program and an OSD-funded Joint Integrated Fire Control (JIFC) demonstration. - 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. The metric for AADI is execution of an ADSAM demonstration by the Navy and Marine Corps that establishes the basis for further development of an operational Naval Integrated Fire Control/Counter-Air (NIFC-CA) capability. - Distributed Weapons Coordination (DWC) open architecture combat system algorithms for Theater Air and Missile Defense (TAMD) Automated Battle Management Aids (ABMA), including Common		34.069	20.211	16.798	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2912

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. Metrics for DWC include (a) increased effectiveness of combat resources through a theater-wide threat evaluation process; (b) increased efficiency of weapons resources through weapon assignment and preferred shooter recommendations considering Theater Ballistic Missile Defense (TBMD) and Area/Ship Defense capability operating simultaneously; and (c) reduced “free riders” (threats not fired at) due to ineffective use of resources (unengaged targets) by 50% (threshold) 80% (objective). - Distributed Sensor Coordination (DSC) algorithms for airborne sensor management in ADSAM and multi-threat air defense engagements. The metric for DSC is effective coordination of airborne sensor resources to support NIFC-CA capability, evaluated using laboratory Monte Carlo simulations within simulated stressing air defense environments. - Naval Interceptor Improvements (NII) technology upgrades for STANDARD Missile (SM) future TAMD missile. Metrics will be to achieve SM performance requirements in specified tactical rain environments and all specified electronic countermeasures environments, while meeting the planned transition date. - Extended Distributed Weapons Coordination (EDWC) algorithms to extend DWC ABMA functionality to include coordination of passive defense measures (emission control, use of decoys, maneuvering). Metrics will be improved probability of negation (Pneg) against advanced ballistic & cruise missile anti-ship threats that may be susceptible to decoys & jamming, while meeting the planned transition date. - Positive Control of Naval Weapons (PCNW) equipment - additional technology upgrades for SM to enable forward relay, remote launch and potentially forward pass engagements. Metrics are classified. - Midcourse and Terminal Algorithms (MTA) for interceptor and associated weapon system enhancements to defeat anti-ship ballistic missile (ASBM) threats with high confidence while retaining or improving baseline capability against advanced anti-ship cruise missiles (ASCM). Specific metrics are classified. - Enhanced Lethality Guidance Algorithms (ELGA) to increase probability of kill versus an expanded threat set including ASBMs and advanced ASCMs. Metrics for this project will be classified. - Enhanced Maneuverability Missile Airframe (EMMA) technology for Navy shipboard missile systems to intercept highly agile maneuvering ASCMs and ASBMs. Metrics for this project will be classified. - Advanced technologies that support delivery of Navy approved FNC enabling capabilities (EC) structured to address operational capability gaps in air and missile defense.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY			PROJECT NUMBER 2912	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Joint Integrated Fire Control (JIFC) S&T planning and preparations, non-FNC expansion of the AADI ADSAM demonstration, to support participation of Army, Air Force and coalition sensor and weapon test assets. The metric for this expanded participation is a series of demonstrations in FY08-09 that show a technology basis for effective interoperability with Navy and Marine Corps participating systems. These additional demonstrations are designed to show the viability of a multi-Service/coalition JIFC capability to defend expeditionary forces from air and missile attacks. Funding decrease in FY 2009 reflects near completion of AADI and completion of DWC and DSC projects. *FY 2008 Accomplishments:* - Continued AADI planning and coordination for FY 2008 Navy ADSAM live-fire demonstration. - Completed testing and demonstration of DWC and DSC algorithms. - Initiated EDWC, NII and PCNW project efforts. - Initiated JIFC demonstration S&T planning and preparations. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as complete above. - Complete AADI project and JIFC effort. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Initiate ELGA and EMMA project efforts.					
SURFACE SHIP & SUBMARINE HULL MECHANICAL & ELECTRICAL (HM&E) Activity includes: Signature Reduction, Hull Life Assurance, 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. Advanced Capability Electric Systems area addresses electrical and auxiliary systems and component technology to provide improvements		16.343	18.866	27.172	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2912

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
in system energy and power density, system operating efficiency, and recoverability from casualties. Advanced Damage Control Countermeasures addresses fire, smoke, and flooding detection using a volume sensor and the use of a hybrid water-mist for electronic space protection. This activity includes support to the Sea Strike, Cross Pillar Enablers, and Enterprise and Platform Enablers (EPE) FNC programs. The increase of funding from FY 2008 through FY 2010 is due to the initiation of new FNC Enabling Capabilities including Underwater Total Ship Survivability, and Affordable Submarine Propulsion and Control Actuator; and the realignment of Compact Power Conversion Technologies from PE 0603236N/ Turbine Engine Technology. *FY 2008 Accomplishments:* - Continued development of diesel fuel reforming technology for molten carbonate and proton exchange membrane fuel cells. - Continued risk reduction activities of advanced superconducting homopolar main propulsion motor with General Atomics. - Continued development of autonomous recovery system for Unmanned Sea Surface Vehicles from a host ship. - Continued development of thermal management technology for shipboard power distribution. - Continued development of Integrated Damage Control Systems which includes Integrated Damage Control Communications and Advanced Magazine Protection System. - Completed development of on-board vehicle power system technologies for future Marine Corps Battlefield Power System. - Initiated Total Ship Survivability Damage Tolerance and Recoverability efforts which include integrated damage control situation awareness technologies. - Initiated expansion of the Next Generation Integrated Power Systems (NGIPS) technology development, to de-risk and demonstrate applicable Medium Voltage Direct Current (MVDC) power dense, efficient, and fault tolerant technologies needed for future surface, and subsurface platforms.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2912

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2009 Plans: - Continue all efforts of FY 2008, less those noted as completed above. - Continue compact power conversion technologies FNC transitioned from PE 0603236N/Turbine Engine Technology. - Complete risk reduction activities associated with advanced direct current homopolar motor with General Atomics. - Initiate expanded demonstration of superconductive degaussing coil in a relevant environment. - Initiate Affordable Submarine Propulsion and Control Surface Actuator technologies focused on the development and demonstration of affordable advanced material propellers and torque dense and quiet actuation of submarine control surface efforts. - Initiate Underwater Total Ship Survivability/Payload Implosion and Platform Damage Avoidance efforts. - Initiate preliminary designs of control surface actuator systems. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete preliminary designs of control surface actuator systems. - Complete expanded demonstration of superconductive degaussing coil in a relevant environment. - Initiate detailed design and breadboard demonstration of control surface actuator systems. - Initiate scaled testing and large scale analysis for ship protection systems. - Initiate Compact Power Conversion Technology Phase 2 Critical Component Development.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2912

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0204152N/E-2 Squadrons									Continuing	Continuing
PE 0205601N/HARM Improvement									Continuing	Continuing
PE 0206313M/Marine Corps Communications Systems									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602123N/Force Protection Applied Research									Continuing	Continuing
PE 0602131M/Marine Corps Landing Force Technology									Continuing	Continuing
PE 0602235N/Common Picture Applied Research									Continuing	Continuing
PE 0602271N/RF Systems Applied Research									Continuing	Continuing
PE 0603235N/Common Picture Advanced Technology									Continuing	Continuing
PE 0603271N/RF Systems Advanced Technology									Continuing	Continuing
PE 0603502N/Surface and Shallow Water Mine Countermeasures									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2912

PE 0603561N/Advanced Submarine System Development		
PE 0603563N/Ship Concept Advanced Design	Continuing	Continuing
PE 0603564N/Ship Preliminary Design & Feasibility Studies	Continuing	Continuing
PE 0603609N/ Conventional Munitions	Continuing	Continuing
PE 0603640M/USMC Advanced Technology Demonstration (ATD)	Continuing	Continuing
PE 0604307N/Surface Combatant Combat System Engineering	Continuing	Continuing
PE 0604518N/Combat Information Center Conversion	Continuing	Continuing
PE 0604558N/New Design SSN	Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

The overall goals of this advanced technology program are the development of technologies which focus on the warfighter and providing 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. Overall metric goals are to transition the advanced technology projects into acquisition programs. Each Activity within this PE has unique goals and metrics, some of which include classified quantitative measurements.

Specific examples of metrics under this PE include:

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2912

- Demonstrate improved performance of main propulsion electric motors and controllers (50% reduced weight and volume) by FY 2011.
- Demonstration of a Medium Voltage Direct Current (MVDC) architecture containing Commercial Off the Shelf (COTS) components to assess the viability of MVDC distribution for CG (X) cruiser by the end of FY 2011.
- In-water successful demonstration of warhead lethality against specified threat at required Closest Point of Approach (CPA).
- Items included within the Missile Defense Activity description.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY					PROJECT NUMBER 3049	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
3049: FORCE PROTECTION	2.132	2.226	2.340						Continuing	Continuing

A. Mission Description and Budget Item Justification

Advanced technologies developed, critical to protecting naval installations, will provide seamless full spectrum protection against asymmetric terrorist 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.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
EMERGING THREATS	2.132	2.226	2.340	
This activity includes: Advanced technologies developed, critical to protecting naval installations, will provide seamless full spectrum protection against asymmetric terrorist 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.				
FY 2008 Accomplishments: - Continued development of lower cost/higher performance Force Protection sensors and automated detection algorithms, and decision support tools. - Continued interim demonstration of prototype Force Protection sensors. - Continued development of intrusion/incident response countermeasures for Force Protection. - Initiated full scale demo of swimmer defense system including sensors and response countermeasures.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY			PROJECT NUMBER 3049	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated interim demonstration of force protection detection and response system with automated detection and self learning algorithms. *FY 2009 Plans:* - Continue all efforts of FY 2008. - Initiate research to reduce force protection manpower and equipment costs through automation and predictive learning algorithms. - Initiate threat characterization research and perception experiments for sensor performance optimization and model development and validation. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete full scale demo of swimmer defense system including sensors and response countermeasures. - Complete interim demonstration of force protection detection and response system with automated detection and self learning algorithms. - Initiate development of all weather sensors optimized for installation force protection. - Initiate research to advance sensor fusion capabilities in high density networks with diverse sensor grids. - Initiate research into sensors for use in counter-surveillance around protected facilities.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 3049

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602123N/Force Protection Applied Research									Continuing	Continuing
PE 0602131M/Marine Corps Landing Force Technology									Continuing	Continuing
PE 0602235N/Common Picture Applied Research									Continuing	Continuing
PE 0603235N/Common Picture Advanced Technology									Continuing	Continuing
PE 0603502N/Surface and Shallow Water Mine Countermeasures									Continuing	Continuing
PE 0603561N/Advanced Submarine System Development									Continuing	Continuing
PE 0603563N/Ship Concept Advanced Design									Continuing	Continuing
PE 0603564N/Ship Preliminary Design & Feasibility Studies									Continuing	Continuing
PE 0604558N/New Design SSN									Continuing	Continuing
PE 0604561N/SSN-21 Developments									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603123N FORCE PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 3049

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

The overall goals of this advanced technology program are the development of technologies which focus on the warfighter and providing 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. Overall metric goals are to transition the advanced technology projects into acquisition programs. Each Activity within this PE has unique goals and metrics, some of which include classified quantitative measurements.

Specific examples of metrics under this PE include:
- Demonstrate improved performance of main propulsion electric motors and controllers (50% reduced weight and volume) by FY 2011.
- Demonstration of a Medium Voltage Direct Current (MVDC) architecture containing Commercial Off the Shelf (COTS) components to assess the viability of MVDC distribution for CG (X) cruiser by the end of FY 2011.
- In-water successful demonstration of warhead lethality against specified threat at required Closest Point of Approach (CPA).
- Items included within the Missile Defense Activity description.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	94.939	90.050	108.394						Continuing	Continuing
2919: COMMUNICATIONS SECURITY	92.426	90.050	108.394						Continuing	Continuing
9999: CONGRESSIONAL PLUS-UPS	2.513	0.000	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

Activities and efforts in this program address 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 promise of net-centricity and potential for persistent and pervasive sensing creates greater demand for automated fusion of large volumes of multi-sensor data, techniques to coordinate deployment of multiple diverse sensors, and tailored dissemination of information to support network centric operations. The focus of this program is to refine technologies that exploit information and networking technology to ensure mission success in unpredictable warfighting environments. These missions include the Overseas Contingency Operations (OCO), urban operations, and asymmetric warfare. To ensure Maritime Domain Awareness, the Navy must be able to collect, fuse, and disseminate enormous quantities of data drawn from US joint forces and government agencies, international coalition partners and forces, and commercial entities. To further network centric capabilities, this project demonstrates 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 rapid, accurate decision-making and result in decisive, precise, and 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.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY

The Common Picture Program supports FORCEnet, Sea Shield and Sea Strike pillars and contains investments in the following Enabling Capabilities (ECs): Secure Collaboration; GIG Compliant Networking; COCOM to Marine Combat ID; Combat ID Information Management of Coordinated Electronic Surveillance; Combat ID in the Maritime Domain to Reveal Contact Intent; Automated Control of Large Sensor Networks; Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC); Dynamic Tactical Communications Networks; Globally Netted Joint/Coalition Force Maritime Component Commander; GWOT Focused Tactical Persistent Surveillance; Actionable Intelligence Enabled by Persistent Surveillance; High Band Width Free-Space Laser Communications; and Real-Time Long Range Air Defense Combat ID in Support of Early Engagements.

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; and 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.

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	92.401	104.578	60.722	
Current BES/President's Budget	94.939	90.050	108.394	
Total Adjustments	2.538	-14.528	47.672	
Congressional Program Reductions		-14.498		
Congressional Rescissions				
Total Congressional Increases				
Total Reprogrammings	4.138			
SBIR/STTR Transfer	-1.600			
Program Adjustments			47.636	
Rate/Misc Adjustments		-0.030	0.036	

Congressional Increase Details ($ in Millions)

	FY 2008	FY 2009
Project: 9999, **COMPUTER FORENSICS FOR ENHANCED MARITIME DOMAIN AWARENESS**	0.965	0.000
Project: 9999, **MARITIME IDENTIFICATION SURVEILLANCE TECHNOLOGY (MIST)**	1.548	0.000

Change Summary Explanation

Technical: Not applicable.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY					PROJECT NUMBER 2919	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
2919: COMMUNICATIONS SECURITY	92.426	90.050	108.394						Continuing	Continuing

A. Mission Description and Budget Item Justification

Activities and efforts in this project address 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 promise of net-centricity and potential for persistent and pervasive sensing creates greater demand for automated fusion of large volumes of multi-sensor data, techniques to coordinate deployment of multiple diverse sensors, and tailored dissemination of information to support network centric operations. The focus of this program is to refine technologies that exploit information and networking technology to ensure mission success in unpredictable warfighting environments. These missions include the OCO, urban operations, and asymmetric warfare. To ensure Maritime Domain Awareness, the Navy must be able to collect, fuse, and disseminate enormous quantities of data drawn from US joint forces and government agencies, international coalition partners and forces, and commercial entities. To further network centric capabilities, this project demonstrates 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 rapid, accurate decision-making and result in decisive, precise, and desired engagement outcomes. The payoff is access to tailored information in near real time with corresponding increases in speed of command, improved decision-making, and reduction in manpower.

The Communications Security project supports FORCEnet, Sea Shield and Sea Strike pillars and contains investments in the following Enabling Capabilities (ECs): Secure Collaboration; GIG Compliant Networking; COCOM to Marine Combat ID; Combat ID Information Management of Coordinated Electronic Surveillance; Combat ID in the Maritime Domain to Reveal Contact Intent; Automated Control of Large Sensor Networks; Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC); Dynamic Tactical Communications Networks; Globally Netted Joint/Coalition Force Maritime Component Commander; GWOT Focused Tactical Persistent Surveillance; Actionable Intelligence Enabled by Persistent Surveillance; High Band Width Free-Space Laser Communications; and Real-Time Long Range Air Defense Combat ID in Support of Early Engagements.

In the context of the Naval Transformation Roadmap construct, this investment will achieve capabilities required by FORCEnet (Persistent Intelligence, Surveillance, and Reconnaissance (ISR); Time Sensitive Strike; and Sea Based Information Operations), Sea Strike (Ship-to-Objective Maneuver), and Sea Shield (Theater Air and Missile Defense).

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY	PROJECT NUMBER 2919

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY	4.211	4.870	0.000	

The overarching objective of this activity is to develop technologies that enable the development of affordable, effective and robust Position, Navigation and Timing (PNT) capabilities, using either GPS systems, non-GPS navigation devices, or atomic clocks. This project will increase the operational effectiveness of U.S. Naval units. Emphasis is placed on (a) GPS Anti-Jam Technology, (b) Precision Time and Time Transfer Technology and (c) Non-GPS Navigation Technology (Inertial aviation system, bathymetry, gravity and magnetic navigation). The focus is on the mitigation of GPS electronic threats, the development of atomic clocks that possess unique long-term stability and precision, and the development of compact, low-cost, Inertial Navigation Systems (INS). The current specific objectives are:

a) GPS Anti-Jam Antennas and Receivers: Develop/demonstrate anti-jam antennas and antenna electronics for Navy platforms for the purpose of providing precision navigation capabilities in the presence of electronic threats; develop, demonstrate and transition anti-spoofer/anti-jam processors for the purpose of providing precision navigation capabilities in the presence of emergent threats.

b) Precision Time and Time Transfer: Develop/evaluate/demonstrate tactical grade atomic clocks that possess unique long-term stability and precision for the purpose of providing GPS-independent precision time; Develop/demonstrate the capability of transferring GPS-derived time via radio frequency links for the purpose of providing GPS-independent precision time.

c) Non-GPS Navigation Technology: Develop/demonstrate an advanced inertial navigation system for the purpose of providing an alternative means of providing precision navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals; Develop, demonstrate and transition a correlation navigation technique using earth maps of high precision (including bathymetric, magnetic and gravimetric data) for navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals.

The following accomplishments and plans are non-inclusive examples of accomplishments and plans for projects funded in this activity.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY		PROJECT NUMBER 2919		
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

This activity transfers to PE 0603271N in FY 2010.

FY 2008 Accomplishments:

GPS Anti-Jam Antennas and Receivers:
- Continued the Enhanced AJ GPS Receiver Technology (EAGRT) project.
- Continued the Advanced Anti-Spoofing Detection and Isolation for GPS Acquisition project.
- Completed the demonstration project of nonlinearly constrained adaptive beam forming for defeating Binary Phase-Shift-Keying (BPSK) jammers. Developed an algorithm to mitigate the loss of Signal-to-Noise Ratio (SNR) through a combination of adaptive space-time-frequency signal processing techniques.
- Initiated the GPS anti-spoofer antenna electronics effort using Electronic Support Measures (ESM) and tracking/location-based system.
- Initiated the Adaptive Temporal Suppression of GPS Structured Interference project.

Precision Time and Time Transfer:
- Continued the development of algorithms for distributed time 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).
- Continued the Qualification of a Commercial-Off-the-Shelf (COTS) Miniature Atomic Clock project.
- Initiated the GPS Synchronization of a Chip-scale Atomic Clock project.

Non-GPS Navigation Technology:
- Continued the development of a small, lightweight Micro-Electro-Mechanical Systems (MEMS) Accelerometer for navigation systems; and fabricated an Electro-Optic Accelerometer.
- Continued the Integrated Optically Transduced Gyro Assembly (IOTA) project.
- Continued the Scaleable Integrated Micro Optical Gyroscope (SIMOG) project.
- Continued the Navigation Grade Microfabricated Integrated Optical Gyro (MIOG) project.
- Continued the Navigation Grade Sub-Harmonic Lateral Mode Gyro (GSLMG) project.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY		PROJECT NUMBER 2919		
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

- Continued the 5-cc accelerometer with the Embedded GPS Inertial (EGI) System for aircraft avionics applications.
- Continued the MEMS Gyro-cluster INS for Tactical Platforms project.
- Continued the Precision Celestial Navigation System (PCNS) project.
- Continued the Dead Reckoning Advanced Tight Coupling (DRATC) project.
- Completed the development of the Sonar Aided Inertial Navigation Technology (SAINT).
- Initiated the navigation grade Inertial Navigation System (INS) using fiber optic/Micro-Electronic Mechanical System (MEMS) gyros and electro-optic accelerometers.
- Initiated the Simultaneous Localization and Mapping (SLAM) Inertial Measurement Unit (IMU) non-GPS Navigator (SINGN) project.

FY 2009 Plans:

GPS Anti-Jam Antennas and Receivers:
- Continue all efforts of FY 2008 less those noted as completed above.
- Complete the development of EAGRT.
- Complete the Advanced Anti-Spoofing Detection and Isolation for GPS Acquisition project.

Precision Time and Time Transfer:
- Continue all efforts of FY 2008.
- Complete the GPS Synchronization of a Chip-scale Atomic Clock project.
- Complete the Qualification of a COTS Miniature Atomic Clock project.

Non-GPS Navigation Technology:
- Continue all efforts of FY 2008.
- Complete the development of IOTA.
- Complete the development of SIMOG.
- Complete the development of MIOG.
- Complete the development of GSLMG.
- Complete the SLAM IMU non-GPS Navigator (SINGN) project.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY	PROJECT NUMBER 2919

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In addition to being performed here in FY 2009, the following efforts transfer to PE 0603271N in FY 2010: GPS Anti-Jam Antennas and Receivers: - Continue the Adaptive Temporal Suppression of GPS Structured Interference project. - Continue the GPS anti-spoofer antenna electronics effort using Electronic Support Measures (ESM) and tracking/location-based system. Precision Time and Time Transfer: - Continue the development of algorithms for distributed time 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). Non-GPS Navigation Technology: - Continue the development of a small, lightweight Micro-Electro-Mechanical Systems (MEMS) Accelerometer for navigation systems; and fabricated an Electro-Optic Accelerometer. - Continue the 5-cc accelerometer with the Embedded GPS Inertial (EGI) System for aircraft avionics applications. - Continue the MEMS Gyro-cluster INS for Tactical Platforms project. - Continue the Precision Celestial Navigation System (PCNS) project. - Continue the Dead Reckoning Advanced Tight Coupling (DRATC) project. - Continue the navigation grade Inertial Navigation System (INS) using fiber optic/Micro-Electronic Mechanical System (MEMS) gyros and electro-optic accelerometers. - Initiate the development of the Sonar Aided Bathymetric Navigation Technology. - Initiate the Optically Transduced MEMS Inertial Navigation System project. - Initiate the Sub-harmonic Lateral Mode MEMS Inertial Navigation System project. - Initiate the Two-Axis Gyro-compass Fiber Optic Inertial Navigation System project.				
HIGH-INTEGRITY GLOBAL POSITIONING SYSTEM (HIGPS)	49.682	46.672	59.110	
The High-Integrity Global Positioning System (HIGPS) activity is focused on developing the technology required to demonstrate the capability of using the existing Iridium satellite constellation to enhance current				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY			PROJECT NUMBER 2919	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
GPS navigation and timing capabilities. Enhancements include improved anti-jam performance, improved accuracy of navigation and positioning, increased availability of satellite navigation signals, improved accuracy in time stability transfer, and faster acquisition times. This activity focuses on integrating a HIGPS Enabling Technology Development (ETD) prototype. This effort is planned to transition to a HIGPS Technology Concept Demonstration (TCD) program under Navy program management at Office of Naval Research. The increase from FY 2009 to FY 2010 is required for procurement of prototype user equipment and completion of HIGPS technology demonstrations in FY 2009. *FY 2008 Accomplishments:* - Initiated and completed the HIGPS Enabling Technology Development (ETD) prototype development which includes development of a HIGPS user receiver (UR) prototype design, development and implementation of prototype HIGPS base station equipment, demonstrations of long baseline precision time transfer, and Iridium ephemeris store and broadcast, and completion of various trade studies required to determine the optimum way forward in implementing the system concept demonstration. - Initiated the HIGPS Technology Concept Demonstration (TCD) project. The HIGPS project continued using the HI GPS ETD as a foundation to assemble a system that will demonstrate the GPS augmentation concept. In FY 2008 the activity was concerned with the system demonstration using Iridium ephemeris store and broadcast, precision time and differential GPS aiding from a base station, an enhanced narrowband Iridium signal, and brassboard user equipment. *FY 2009 Plans:* - Continue the HIGPS TCD project. *FY 2010 Plans:* - Continue the HIGPS TCD project.				
INFORMATION SECURITY RESEARCH		1.737	1.940	1.821	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY	PROJECT NUMBER 2919

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
The overarching objective of this activity is to protect the Navy and the Joint information infrastructure from hostile exploitation and attack. The current specific objectives are: a) Network Situation Awareness & Security: Develop tools, techniques and methodologies to improve network resistance to denial of service attacks and improve indications and warnings of suspect activities. b) Network Traffic Analysis and Assessment: Develop methods for conducting network traffic analysis; monitoring and assessing network status and health; identifying new capabilities to analyze network vulnerabilities and attacks; and providing situational awareness of network assets and operations. c) Information Assurance: Develop and measure the effectiveness of Information Assurance (IA) protective solutions and improve the quality and level of certification of information assurance software. The following accomplishments and plans are non-inclusive examples of accomplishments and plans for projects funded in this activity. *FY 2008 Accomplishments:* Network Situation Awareness & Security: Develop tools, techniques and methodologies to improve network resistance to denial of service attacks and improve indications and warnings of suspect activities: - Continued 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. Network Traffic Analysis and Assessment: - Continued development of the security management tool that provides a common picture of the networked environment with respect to IA and security, with emphasis on visualization capabilities to support active computer network defense.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY	PROJECT NUMBER 2919

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated the development of capabilities and an infrastructure that will support the management of high assurance devices/components used within Navy networks. Ensured the approach was supported by the Navy's network centric architecture. Information Assurance: - Continued development of integrated capabilities that support battle damage assessment and infrastructure and asset protection based on information provided by the common picture of the networked environment with respect to IA and security. Evaluated and demonstrated the capabilities in an operationally representative environment and used the results to improve the capabilities. - Initiated the development of a tool suite that will provide evidence of assurance for security products based on the foundations of formal methods. The tool will provide the automated analysis of the implementation based on the security policy, the architecture and/or the software security critical functions. *FY 2009 Plans:* Network Situation Awareness & Security: - Continue all efforts of FY 2008. Network Traffic Analysis and Assessment: - Continue all efforts of FY 2008. Information Assurance: - Continue all efforts of FY 2008. - Complete the development of integrated capabilities that support battle damage assessment and infrastructure and asset protection based on information provided by the common picture of the networked environment with respect to IA and security. *FY 2010 Plans:* Network Situation Awareness & Security: - Continue all efforts of FY 2009.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY			PROJECT NUMBER 2919	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Complete 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. - Initiate new high assurance security protocols for networks and communications infrastructure with particular emphasis on attack resistance and security management. Network Traffic Analysis and Assessment: - Continue all efforts of FY 2009. Information Assurance: - Continue all efforts of FY 2009 less those noted as completed above. - Complete a tool suite that will provide evidence of assurance for security products based on the foundations of formal methods that will provide the automated analysis of the implementation based on the security policy.					
KNOWLEDGE SUPERIORITY AND ASSURANCE (KSA) A portion of this activity is devoted to mid-term technology development in close concert with programs of record. The products of these efforts are expected to transition at the end of their schedule into the associated acquisition programs of record. This activity area also appears in PE 0602235N. The aspects of a given Enabling Capability (EC) in PE 0602235N focus on component technology, while this PE focuses on the integration of the components and on demonstrations. Warfighter Capability Gaps are being addressed by EC's. 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. The Future Naval Enabling Capabilities in this activity span across the Information Infrastructure, Applications/Tools/Decision Aids, Command and Control, Apertures and Radios, and Tactical Networks and Network Control/Management technology areas. Technologies being developed will integrate sensors, networks, decision aids, weapons and supporting systems into a highly adaptive, human-centric, comprehensive maritime system. This system will operate from the sea bed to space in a Service Oriented Architecture (SOA) that can be used in a Joint Environment. To accomplish this information		33.972	36.568	47.463	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY	PROJECT NUMBER 2919

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
integration, efforts are underway to develop rapid, accurate decision making and dynamic, efficient, mission-responsive communications and networks. Objectives of the current EC's are: a) COCOM to Marine Combat ID: Develop technologies that enable all Naval forces to quickly obtain and exchange Blue Force information and provide global synchronization tools in an SOA. b) Secure Collaboration: Develop technologies that support a Multi-Level Secure (MLS) web server which facilitates Joint/Coalition collaboration in a trusted environment. The payoff for the warfighter is the ability to share data objects quickly, securely, and cost-effectively across security domains. The technology will eliminate cross-domain content synchronization problems, reduce the cost of joint/coalition collaboration and require no changes/additions to existing networks or user workstations. c) GIG Compliant Networking: Develop technologies that support Global Information Grid (GIG) compliant networking. Specifically, a high altitude, high data rate relay and router for ship-to-ship and ship-to-shore operations will be developed. Other efforts will use an approach to reduce Line of Sight (LOS) antennas on Large Decks and increase performance through an advanced multi-function, RF distribution for VHF-UHF radios. This technical development will use an architecture which allows for integrated elements into superstructure. d) Combat ID Information Management of Coordinated Electronic Surveillance: Develop capability to dynamically re-task organic sensors in conjunction with fused intelligence products to support Command Control and Combat Systems. Efforts will include capability for automated integration of multi-intelligence surveillance & reconnaissance of red, white, and blue force locations for Combat Identification by providing software integrated into Navy and Marine Corps Command Control and Combat Systems. Demonstrations will be conducted in an operational Sea Trial environment. The benefits to the war-fighter include: More effective use of tactical sensors to maintain track and identify consistent with Commander's priorities; tactical sensor resources allocated effectively to complement Intelligence coverage; reduction in exposure of friendly forces to hostile action; order of magnitude reduction to false recognition and improper identification of significant military entities consistent with sensor capabilities; SOA enabled applications and infrastructure.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY			PROJECT NUMBER 2919	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

e) Combat ID in the Maritime Domain to Reveal Contact Intent: Develop an automated capability to understand and interpret relationships among objects in the context of the maritime environment to include threat prediction and intent as well as event outcome assessment. Benefits to the Naval decision-maker include: automated interpretation of asset relationships and threat/impact assessment; automated processing over wide disparate datasets; recognition of anomalies, and proactive means to confirm or discount suspicious activity; framework extension of fusion to a real-time SOA enterprise environment.

f) Automated Control of Large Sensor Networks: Develop a capability for automated and mission specific tactical sensor fields capable of fulfilling specific mission objectives with smart sensors that are capable of forwarding knowledge vice raw data. Technical development efforts also include a fusion engine capable of translating tactical sensor data into appropriate situational awareness for battalion level forces and below. Integration of the tactical sensor network with Distributed Common Ground System (DCGS) will assure that fusion, visualization, resource management and information dissemination engines run seamlessly from the individual Marine to the Commander, Joint Task Force (CJTF).

g) Focused Tactical Persistent Surveillance: Develop a netted, organically controlled, adaptive sensor field that is capable of detecting and classifying features relevant to the global war on terror. This includes organic sensors for small tactical expeditionary units, capable of supporting the dynamic character of modern operations from the highly mobile to the long-term. Also, Tracking, Tagging and Locating (TTL) technical development of Quantum dot, Electro-Optic (EO) phase shifted and optical tags for use against vehicles and high priority entities. Finally the effort includes technical development to enhance tactical sensor communications for a two-way high data rate radio. Technology allows for automatic adaptation of waveforms for increased network capacity.

h) Globally Netted Joint/Coalition Force Maritime Component Commander: Develop ‘globally- networked, theater-focused’ maritime capabilities to enhance Joint Task Force (JTF) and COCOM’s’ ability to execute their intentions. The efforts will support multiple users and multiple roles to access data at any command echelon; provide consistent, qualified, and traceable operational & tactical maritime information across theaters; provide pedigree to provide a clear representation of complex situation and threat elements;

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY		PROJECT NUMBER 2919		
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

supports user interaction across the SOA environment. The benefits to Naval forces include: exploitation of navy presence FORWARD to monitor vessels, people, cargo and designated missions, areas of interest within the global maritime environment; access to all relevant databases; and collection, analysis, and dissemination of relevant information.

i) Dynamic Tactical Communications Networks: Develop, integrate and demonstrate dynamically adaptive automated software algorithms, protocols, and network management techniques that provide a rapidly auto-configuring and self-organizing networking capability. This capability will adapt to available links of opportunity at lower echelons and assure priority movement of critical data intra-network and through reachback gateway networks that interface with the Global Information Grid (GIG) across multiple security/routing domains. Benefits of this effort to the war-fighter include: timely exchange of situational awareness and C2 information for the Naval Expeditionary Combatant forces; high throughput tactical network access/delivery, SOA and coalition interoperability through a reliable communications grid; ad-hoc re-tasking and targeting of warriors, weapons and sensors with minimum human intervention; shortened kill chain for tactical engagement missions.

j) Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC): Develop a capability that will provide the maritime commander with agile and responsive control and management of tactical ASW interactions in a net-centric enterprise environment. Focus will address classified ASW requirements for command and control at the tactical level. Benefits to Naval forces include flexible command and control among tactical units with severely degraded communications with the Maritime Operations Center.

k) High-bandwidth Free-space Lasercomm: Develop an affordable, reliable and high-bandwidth Free-Space Laser Communications (Lasercomm) capability which is adaptive and agile in mitigating a wide range of atmospheric and sea surface/state turbulence, precipitation and obscuration conditions. Benefits include real-time high-bandwidth direct ship-ship, ship-air and ship-shore links in RF denied environments; enhanced reachback for Forward Operating Bases (FOB) to Marine expeditionary Command Operation Centers (COC) with limited SATCOM access; and) biometrics information sharing between Marine Interdiction Operation (MIO) parties.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY	PROJECT NUMBER 2919

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
l) Actionable Intelligence Enabled by Persistent Surveillance: Develop a capability to provide accurate threat detection by exposing the enemy's vulnerabilities, unmasking their latent networks, discovering their tactics, techniques, procedures and exploiting in new ways the vast amount of sensor data available today against an irregular threat. Also being developed: an electro-optical, infrared and laser Intelligence, Surveillance, and Reconnaissance Targeting (ISRT) optics technology, capable of wide Field of View/Field of Range (FOV/FOR) at variable resolution & pointing direction, for installation in mobile platforms without gimbals; a light weight, low cost sensor suite and autonomy algorithms to enable detection and avoidance of all classes of aircraft or Unmanned Aerial Vehicles (UAV). m) Real-Time Long Range Air Defense Combat ID in Support of Early Engagements: Develop a capability to provide real-time long range air defense combat ID in support of early engagements. Specific efforts support Naval Integrated Fire Control - Counter Air (NIFC-CA) capability by enabling fleet Theater Air Missile Defense (TAMD) units to use real-time and non-real time sensor and ISR data to rapidly build ID on long-range contacts. Demonstrations will be conducted during at-sea exercises, live fly events, and in a System of Systems (SoS) test environment. The following accomplishments and plans are non-inclusive examples of accomplishments and plans for projects funded in this activity. The increase from FY 2009 through FY 2010 is due to the initiation of 5 new FNC ECs and to the expansion of investment within ECs which will commence in FY 2009. New EC initiations for FY 2010 include: Free-space Optical Terminal (FOT), Modulating Retro-reflector Unit (MRU), Autonomous UAV Collision Avoidance System, Operational Adaptation Enterprise Services, and Ultra Wide FOV Area Surveillance System. The shift in FNC investment within 0603235N is consistent with overall program objectives and maturation of research initiatives within this PE. FNC program investment remains consistent with prior year plans and Navy objectives and approval. *FY 2008 Accomplishments:* COCOM to Marine Combat ID:				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY	PROJECT NUMBER 2919

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued efforts on 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 ensured warfighting COIs access to information required from any source for rapid situation awareness assessment. Secure Collaboration: - Completed development of Secure, Distributed Collaboration effort. Transitioned to the PEO for C4I and Space for the Combined Enterprise Regional Information Exchange System (CENTRIXS) for secure collaboration across multiple coalition boundaries and security levels in the maritime environment. GIG Compliant Networking: - Completed Ultra High Frequency (UHF)/L-Band phased array antennas for carriers. - Completed the High Altitude Airborne Relay and Router Package to deliver relay/router packages for high and medium altitude platforms across UHF/VHF and Ku-Bands. Combat ID in the Maritime Domain to Reveal Combat Intent: - Continued the development of algorithms and software that will provide an automated capability to understand and interpret relationships among objects in the context of the maritime environment to include threat prediction and intent as well as event outcome assessment. - Continued the development and demonstration of software that provides the capability to extract anomalies and provide basic reasoning techniques to separate false alarms from true anomalies. Tests will be conducted in both Limited Technology Experiments and Sea Trials. - Continued the development and demonstration of smart algorithms for each sensor type that enables the translation of signals to information at the node; tactical multi-INT fusion algorithms; enhancements allowing for the fusion of tactical and higher sourced data and for the combined translation of information to actionable intelligence; and a tactical service oriented architecture. Automated Control of Large Sensor Networks: - Continued the development and demonstration of smart algorithms for tactical sensors that can process data at the node in a battery efficient manner; an ability to generate behavioral indications and warnings				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY			PROJECT NUMBER 2919	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

based on detected alerts across disparate data sources; and functional extensions of a service oriented environment down to the most tactical node.

Focused Tactical Persistent Surveillance:
- Initiated the development of a netted, organically controlled, adaptive sensor field that is capable of detecting and classifying features relevant to the global war on terror. This includes organic sensors for small tactical expeditionary units, technical development of Quantum dot, Electro-Optic (EO) phase shifted and optical tags for use against vehicles and high priority entities, and technical development to enhance tactical sensor communications for a two-way high data rate radio.

Globally Netted Joint/Coalition Force Maritime Component Commander:
- Initiated development of technology to enable the coordinated Global Joint and Coalition Force Maritime Component Commander (J/CFMCC) capture and share information from sources and processes; with the intended result of managing at least 10,000 tracks per day in a consistent manner to support user awareness and control (current capability is approximately 200 tracks per day globally).

FY 2009 Plans:

COCOM to Marine Combat ID:
- Complete the Joint Coordinated Real-Time Engagement (JCRE) Advance Concepts Technology Demonstration (ACTD) to provide GIG-compliant core enterprise Services and COI Services which will ensure warfighting COIs access to information required from any source for rapid situation awareness assessment.

Combat ID Information Management of Coordinated Electronic Surveillance:
- Initiate the development of software that will provide the capability to dynamically re-task organic sensors in conjunction with fused intelligence products to support Command Control and Combat Systems. Efforts will include capability for automated integration of multi-intelligence surveillance & reconnaissance of red, white, and blue force locations for Combat Identification by providing software integrated into Navy and Marine Corps Command Control and Combat Systems.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY	PROJECT NUMBER 2919

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiate the development and demonstration of the service oriented network-centric architecture for adapting multi-sensor fusion and adaptive resource management across a network of intelligence sensors in an operational (Sea Trial) environment. Combat ID in the Maritime Domain to Reveal Contact Intent: - Continue all efforts of FY 2008. Automated Control of Large Sensor Networks: - Continue all efforts of FY 2008. - Initiate the development, integration and demonstration of high information tactical agile sensors, including a tactical wide area surveillance UAV payload, tactical RF sensors, sensors to sense the state of a person and smart tactical imagers and acoustic sensors; of novel high bandwidth communications links for tactical UAVs and battery powered high information content tactical sensors; and airborne readers of optical tags. Focused Tactical Persistent Surveillance: - Continue all efforts of FY 2008. Globally Netted Joint/Coalition Force Maritime Component Commander: - Continue all efforts of FY 2008. - Initiate the development, integration, and demonstration in Sea Trials the near real time ability to access all relevant databases and collect, analyze and disseminate relevant information to Maritime Component Commanders. Dynamic Tactical Communications Networks: - Initiate effort to develop and apply emerging technologies that support self-organizing networking and assured communications exchange in tactical communications networks. - Initiate development, integration and demonstration of wireless network auto-configuration and self-organization (including dynamic partitions and merge) algorithms and protocols; distributed and dynamic policy based network management and secure mobility management solutions; network service discovery				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY	PROJECT NUMBER 2919

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
mechanisms and network-aware middleware-enabled applications; inter-domain (security and routing) protocols for fully-connected domains; and robust and bandwidth efficient group communication protocols for the tactical environment, including disruption tolerance. Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC): - Initiate effort to mature, demonstrate and apply emerging technologies that support dynamic and response management and control of net-centric enterprise theater and tactical ASW operations. This includes automation support for synchronized planning of resources and multi-mission execution, and access and shared awareness of data, activities and status among Maritime Operation Centers and tactical forces in a tactical netted service-oriented architecture (SOA) environment. - Initiate the development, integration and demonstration of SOA tactical services that support C2 by providing decision-quality information to the commander much more rapidly than in the past, and in response to unanticipated changes in operational requirements using data management with disconnected, intermittent, or limited communications paths; shared awareness of track data; adaptation to network conditions; and automated and real-time composition of existing tactical enterprise services to accomplish a new C2 function. - Initiate the development and demonstration of automated techniques for force planning and allocation of resources based on information as it is passed from the Operational Level MOC to the local-tactical level and from local-tactical centers to adjacent local-tactical centers. *FY 2010 Plans:* Combat ID Information Management of Coordinated Electronic Surveillance: - Complete the development of software that will provide the capability to dynamically re-task organic sensors in conjunction with fused intelligence products to support Command Control and Combat Systems. Efforts will include capability for automated integration of multi-intelligence surveillance & reconnaissance of red, white, and blue force locations for Combat Identification by providing software integrated into Navy and Marine Corps Command Control and Combat Systems. - Complete the development and demonstration of the service oriented network-centric architecture for adapting multi-sensor fusion and adaptive resource management across a network of intelligence sensors in an operational (Sea Trial) environment.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY	PROJECT NUMBER 2919

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Combat ID in the Maritime Domain to Reveal Contact Intent: - Continue all efforts of FY 2009. Automated Control of Large Sensor Networks: - Continue all efforts of FY 2009. - Continue the development and demonstration of smart algorithms for tactical sensors that can process data at the node in a battery efficient manner; an ability to generate behavioral indications and warnings based on detected alerts across disparate data sources; and functional extensions of a service oriented environment down to the most tactical node. Tests will be conducted in an Advanced Warfighting Experiment. Focused Tactical Persistent Surveillance: - Continue all efforts of FY 2009. - Initiate development, integration, and demonstration of high information tactical agile sensors, including a tactical wide area surveillance UAV payload and an RF payload for a tier-2 UAV. - Initiate development, integration, and demonstration of a distributed architecture of smart metadata and analysis tools. Globally Netted Joint/Coalition Force Maritime Component Commander: - Continue all efforts of FY 2009. Dynamic Tactical Communications Networks: - Continue all efforts of FY 2009. Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC): - Continue all efforts of FY 2009. High-bandwidth Free-Space Lasercomm:				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY			PROJECT NUMBER 2919	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate the development of software/hardware for mitigation techniques for laser beam propagation through atmospheric turbulence and aerosol obscuration; fast acquisition and fine beam steering/ tracking algorithms; characterization of performance/affordability of mechanical steering to not-so-mature electronic steering approaches under the Adaptive Photonic Phase-Locked Elements (APPLE) program. - Initiate the development of wide-area avalanche photo-diode receive array techniques; high bandwidth wide field-of-view retro-reflector optics; and adaptive bit rate and transmit power control. - Initiate the development and integration of turbulence mitigation techniques to dual-mode free-space optical terminal electronics/optics. - Initiate the development and demonstration of adaptive bit rate (10 Mbps-1 Gbps) and transmit power control; wide-area avalanche photo-diode receive array technique; high bandwidth wide field-of-view retro-reflector optics. - Initiate the development of platform specific (e.g., P3/E2-C or ship or sub periscope mount) terminal configuration and 'disadvantaged platform' specific retro-reflector configuration. Actionable Intelligence Enabled by Persistent Surveillance: - Initiate development, integration and demonstration of an active liquid crystal lens for a very high resolution focal plane array, a distributed architecture of smart meta data and analysis tools, and control laws that allow a tier-2 UAV to satisfy flight safety standards required in manned airspace.					
MULTI-SOURCE INTEGRATION (MSI) AND COMBAT IDENTIFICATION (CID) Multi-Source Integration (MSI), Advanced Sensor Netting Technology (ASNT), and Composite Combat Identification (CCID) technology 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. This effort develops 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 supports the Sea Shield Enabling Capability for Real Time Long Range Air Defense CID in Support of Early Engagements and related CID Science & Technology to be worked under FORCEnet. Decrease from FY 2008 reflects the completion of efforts within this activity in FY 2008.		2.824	0.000	0.000	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY	PROJECT NUMBER 2919

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2008 Accomplishments: Real-Time Long Range Air Defense Combat ID in Support of Early Engagements: - Completed technology transition to the E-2C/D Program Management Office (PMA-231), Intelligence, Surveillance, Reconnaissance, and Information Operations Program Office (PMW-180), and PEO-IWS.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY	PROJECT NUMBER 2919

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0204152N/E-2 Squadrons									Continuing	Continuing
PE 0205601N/HARM Improvement									Continuing	Continuing
PE 0206313M/Marine Corps Communications Systems									Continuing	Continuing
PE 0303140N/Information Systems Security Program									Continuing	Continuing
PE 0308601N/Modeling and Simulation Support									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602114N/Power Projection Applied Research									Continuing	Continuing
PE 0602123N/Force Protection Applied Research									Continuing	Continuing
PE 0602131M/Marine Corps Landing Force Technology									Continuing	Continuing
PE 0602235N/Common Picture Applied Research									Continuing	Continuing
PE 0602236N/Warfighter Sustainment Applied Research									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY	PROJECT NUMBER 2919

PE 0602271N/ Electromagnetic Systems Applied Research		
PE 0603114N/Power Projection Advanced Technology	Continuing	Continuing
PE 0603123N/Force Protection Advanced Technology	Continuing	Continuing
PE 0603236N/Warfighter Sustainment Advanced Technology	Continuing	Continuing
PE 0603271N/ Electromagnetic Systems Advanced Technology	Continuing	Continuing
PE 0603609N/ Conventional Munitions	Continuing	Continuing
PE 0603640M/USMC Advanced Technology Demonstration (ATD)	Continuing	Continuing
PE 0603658N/Cooperative Engagement	Continuing	Continuing
PE 0603750D8Z/ Advanced Concept Technology Demonstrations	Continuing	Continuing
PE 0604307N/Surface Combatant Combat System Engineering	Continuing	Continuing
PE 0604518N/Combat Information Center Conversion	Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603235N COMMON PICTURE ADVANCED TECHNOLOGY	PROJECT NUMBER 2919

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Performance metrics are discussed within the project (R2a).

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	90.353	137.458	86.239						Continuing	Continuing
2915: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	80.005	112.167	86.239						Continuing	Continuing
9999: CONGRESSIONAL PLUS-UPS	10.348	25.291	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval Science and Technology (S&T) Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential S&T efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

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 Future Naval Capabilities (FNC) Programs 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.

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.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	101.007	112.520	101.051	
Current BES/President's Budget	90.353	137.458	86.239	
Total Adjustments	-10.654	24.938	-14.812	
Congressional Program Reductions		-0.373		
Congressional Rescissions				
Total Congressional Increases		25.360		
Total Reprogrammings	-10.000			
SBIR/STTR Transfer	-0.654			
Program Adjustments			-14.856	
Rate/Misc Adjustments		-0.049	0.044	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **CHAFING PROTECTION SYSTEM**	0.000	1.197
Project: 9999, **DEFENSE MODERNIZATION AND SUSTAINMENT INITIATIVE**	0.000	4.986
Project: 9999, **DESKTOP VIRTUAL TRAINER FOLLOW-ON**	0.000	2.394
Project: 9999, **DOMAIN SPECIFIC KNOWLEDGE CAPTURE INTERFACE**	0.000	1.356
Project: 9999, **ENVIRONMENTALLY-SEALED RUGGEDIZED AVIONICS DISPLAYS FOR VERTICAL LIFT SYSTEM**	1.548	3.988
Project: 9999, **INTELLIGENT WORK MANAGEMENT FOR CLASS SQUADRONS (CLASSRONS)**	0.000	1.995
Project: 9999, **LITTORAL COMBAT SHIP (LCS) NETWORKED TACTICAL TRAINING SYSTEM (NTTS)**	0.965	0.000
Project: 9999, **NADEP CHERRY POINT CENTER FOR VERTICAL LIFT - INSTITUTE FOR MAINTENANCE SCIENCE AND TECHNOLOGY**	2.332	0.000
Project: 9999, **NATIONAL CENTER FOR RESEARCH ON EVALUATION, STANDARDS, AND STUDENT TESTING (CRREST) SKILL SET ANALYSIS**	2.314	0.000
Project: 9999, **PREDICTING BIO-AGENT THREAT PROFILES USING AUTOMATED BEHAVIOR ANALYSIS**	0.000	1.596
Project: 9999, **PROTECTIVE APPAREL TECHNOLOGY SYSTEMS**	0.771	0.000

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **SEA BASE MOBILITY AND INTERFACES**	0.000	4.986
Project: 9999, **SYSTEM FOR INTELLIGENT TASK ASSIGNMENT & READINESS (SITAR)**	0.000	0.798
Project: 9999, **VALIDATION OF LIFT FAN ENGINE SYSTEMS**	2.418	1.995

Change Summary Explanation

Technical: FY 2009 and out reflects a correction to the Seabasing INP funding profile to be consistent with the changes in complexity and cost associated with going from preliminary design and model development through prototype fabrication.

Schedule: Not applicable

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY					PROJECT NUMBER 2915	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
2915: WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	80.005	112.167	86.239						Continuing	Continuing

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. This project supports FNC Programs in Airframe/Ship Corrosion; Turbine Engine Technologies; Littoral Combat; Sea Base Planning, Operations and Logistics; and Sea Base Mobility and Interfaces. This project 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. 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 (ASW) 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 ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
AIRFRAME/SHIP CORROSION/COST REDUCTION TECHNOLOGIES	2.455	2.895	4.668	
This activity includes an integrated approach for the control of the effects of external and internal corrosion in Naval weapon systems as well as cost reduction technology efforts. The work develops advanced, cost effective prevention and lifecycle management technologies. This is particularly significant to life extension for the aging fleet. The funding profile from FY 2008 to FY 2009 reflects the reorganization of the FNC Program investments into EC's. The funding increase from FY 2009 to FY 2010 is due to the initiation and ramp-up of several new EC's including corrosion related signature technologies and advanced shipboard water desalination and corrosion.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	PROJECT NUMBER 2915

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2008 Accomplishments: - Continued Nondestructive Inspection (NDI) technology for heat damage detection on composite materials. - Initiated development on improved non-skid coatings. - Initiated development on improved ship rudder coatings. - Initiated development on high performance topside coatings - Initiated development on high performance airfield pavements. *FY 2009 Plans:* - Continue all efforts of FY 2008. - Initiate evaluation of advanced material coatings for erosion control on helicopter main rotor blade leading edges. *FY 2010 Plans:* - Continue all effort of FY 2009. - Complete evaluation of advanced materials for erosion control on helicopter main rotor blade leading edges. - Initiate down select of materials for erosion control of helicopter main rotor blade leading edges for subsystem evaluation of performance. - Initiate evaluation and correlation of materials repair technologies related to sub-system materials for erosion control on helicopter main rotor blade leading edges. - Initiate evaluation, design and demonstration of advanced ASGS (Active Shaft Grounding System) with Condition Based Maintenance (CBM) and signature control. - Initiate evaluation, design, large scale testing and demonstration of Impressed Current Cathodic Protection (ICCP) components. - Initiate evaluation, design and demonstration of dual-use ICCP and novel sensor technology for CBM and closed-loop deamping. - Initiate testing and evaluation of diagnostic models and demonstration of materials with improved barrier dielectrics.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY			PROJECT NUMBER 2915	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate evaluation, testing and demonstration of CBM underwater hull analysis model integrated with closed loop deamping model.					
FRICTION DRAG REDUCTION This activity 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 2008 - 2009 funding profile reflects the phased completion of the Friction Drag Reduction program at the end of FY 2009. *FY 2008 Accomplishments:* - Initiated design of large-scale demonstrator; modify demonstrator to install drag reduction equipment and sensors. - Initiated at-sea large-scale demonstrator test. - Initiated design of an optimal implementation of additive-based drag reduction technology using large-scale predictive models. *FY 2009 Plans:* - Complete large-scale flat-plate test and data reduction.		2.436	1.206	0.000	
HUMAN SYSTEMS INTEGRATION This effort supports the warfighter by providing enhanced capabilities by designing affordable user-centered systems that are efficient, easy to use, and provide required mission capabilities at lowest lifecycle costs. Such systems will be optimally designed for the right number and types of personnel, requiring minimum training while providing high skills retention. This field of research is paramount to the reduction in complex naval systems design, acquisition, operation, and maintenance costs and improvements in the effectiveness of operations. Congressional,		3.841	4.898	6.137	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	PROJECT NUMBER 2915

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
DoD, and Navy policies and instructions require Navy and Marine Corps Program Managers to have a comprehensive plan for Human Systems Integration (HSI) in the acquisition process to optimize total system performance, minimize total ownership costs, and ensure the system is built to accommodate the characteristics of the user population that will operate, maintain, and support the systems. A strong HSI effort is required to meet these goals. The funding increase from FY 2008 to FY 2009 supports research in commanding officer/crew decision making and studies for control and monitoring multiple unmanned vehicles. The increase in funding from FY 2009 to FY 2010 supports research into mission performance optimization encompassing task centered design and advanced human performance modeling and also research into improving delivery of sensor information to displays for enhanced understanding of uncertain information. *FY 2008 Accomplishments:* - Initiated research to develop and demonstrate automation and human interface technologies to support collaborative decision-making in which multiple unmanned system operators manage groups of vehicles with optimal manning. - Initiated research to develop and demonstrate advanced tactical decision making technologies to integrate spatially disparate displays and reduce the reliance of crew support to achieve superior ship commanding officer and crew decision making. - Initiated HSI interface display research to improve ships personnel's ability to efficiently and effectively detect, recognize, and identify noisy targets in ambiguous and uncertain dynamic environments. - Initiated HSI tool research, development, and application to engineering efforts to develop robust standardized set of human systems integrated specific modeling and simulation tools to assess the interaction between operators performance by system design by manning levels. *FY 2009 Plans:* - Continue all efforts of FY 2008. - Initiate experiments to study design issues related to simultaneous control and monitoring of a multiple unmanned surface and air vehicles. Of particular importance are issues monitoring and control of				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	PROJECT NUMBER 2915

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
multiple vehicles, planning and re-planning as environmental findings from sensors are interpreted, and safety and collision avoidance. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete HSI interface display research to improve ships personnel's ability to efficiently and effectively detect, recognize, and identify noisy targets in ambiguous and uncertain dynamic environments. - Complete experiments to study design issues related to simultaneous control and monitoring of a multiple unmanned surface and air vehicles. - Initiate research into mission performance optimization encompassing task centered design and advanced human performance modeling for achieving the requisite manning, both in numbers and capabilities, for the complex ships and systems of the future fleet. - Initiate improving the capability to fuse imaging, electronic warfare, inorganic and acoustic sensor inputs into integrated, fused, and intuitive displays that enhance the presentation and command understanding of uncertain information.				
LITTORAL COMBAT 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. The activity includes support to the following FNC ECs; Battlefield Power, Reduced 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, Reduced Cost of Operations 1, Sea Base Collaborative Command and Control, Sea Base Mobility and Interfaces, and Sea Base Integrated Operations. The FY 2008 to FY 2009 increase reflects initiation of a new FNC effort to develop enhanced individual protective systems for the Warfighter. The increase in funding between FY 2009 and FY 2010 is due to	2.309	6.246	9.823	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY			PROJECT NUMBER 2915	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
the initial funding of FNC efforts for advanced survivability and mobility for Marine Corps, and the initiation of new FNC efforts to reduce the load of dismounted combatants. *FY 2008 Accomplishments:* - Continued development of battlefield power generation technologies lunchbox sized 500 – 1000W portable JP-8 fueled generator. *FY 2009 Plans:* - Continue all efforts of FY 2008. - Initiate development of advanced lighter weight modular individual protective system that will provide increased flexibility and protection for the warfighter. (Concurrent effort funded by PE 0602131M and PE 0603640M). *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete development and transition advanced power generation technologies that enable reduction of the logistical burden on small tactical units. - Initiate development of advanced armor technologies for improved survivability and advanced suspension technologies for improved cross country mobility of Marine Corps tactical and combat vehicles.(Previous FY 2009 funding by PE 0602131M and 0603640M; concurrent funding by PE 0602131M and PE 0603640M- funding by these PEs completes development and transition). - Initiate development of individual warfighter lightweight protective system technologies that will reduce body armor weight, improve survivability and increase the mobility of the warfighter. (Concurrent funding provided by PE 0602236N) - Initiate research to develop technology to reduce fabrication and life cycle costs of SSN/SSGN next generation photonics mast and to improve SSN surface situational awareness through faster image acquisition rates, improve range performance under adverse weather conditions and improve autonomous detection and classification.(Concurrent funding provided by PE 0602236N).					
MANPOWER AND PERSONNEL DEVELOPMENT		5.196	5.229	5.157	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY			PROJECT NUMBER 2915	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
This activity provides Navy personnel system managers with the ability to attract and retain the right people and to place them in jobs that best use their skills, training, and experience. Application of modeling and simulation, mathematical optimization, advanced testing, statistical forecasting, information visualization, data warehousing, data cleansing, web-based knowledge management, and human performance measurement technologies enhances Fleet readiness and reduces personnel costs. *FY 2008 Accomplishments:* - Initiated development and demonstration of decision support tools linked with Sea Warrior. - Initiated advanced selection, classification and assessment metrics to facilitate optimal labor substitution. - Initiated integration and multi-faceted decision support tools to evaluate manpower alternatives. - Initiated development and demonstration of behaviorally-based predictive models. *FY 2009 Plans:* - Continue all efforts of FY 2008. - Initiate experiments and demonstration of independent dynamic supply and demand models for Navy skill sets. - Initiate development of a prototype assessment measure of team adaptive performance. *FY 2010 Plans:* - Continue all efforts of FY 2009.					
SEA BASE MOBILITY AND INTERFACES This activity includes support for Sea Base Mobility and Interfaces and Force Closure. This activity improves the capability for transfer of cargo between Sea Base/Logistics vessels and employment of combat ready forces over unimproved beaches during high sea states. Capabilities being developed include propulsion technologies, maneuvering technologies, and advanced hull systems technologies needed for sustained operations at high speed in high sea states. This activity further supports the		15.647	23.977	7.676	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	PROJECT NUMBER 2915

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Seabasing mission of transporting troops, equipment, and materials from the seabase to shore, and providing support to seaborne forces via surface distribution interfaces. FY 2008 - FY 2009 increase results from the planned initiation of projects to support the Navy's developing seabasing concept of operations, to support planned product transitions to new ship programs through land-based and at-sea demonstrations, and to reflect the realignment of FNC Program investments into ECs. Funding increases between FY 2008 and FY 2009 support several programs that are at the stage where the actual large-scale technology demonstration systems are being manufactured and/or undergoing shipboard integration for major At-Sea Demonstrations that are scheduled to occur in FY 2009. Additionally, funding growth is required for fabrication of large scale test articles, to support FY 2009 at-sea and land-based technology demonstrations. The reduction between FY 2009 and FY 2010 is due to the completion of the following FNC programs: small to large vessel at sea transfer, high speed seabase to shore connector, high rate horizontal to vertical movement. The transition opportunity for the Axial Flow Waterjet FNC Program has been changed from the Joint High Speed Ship to the Littoral Combat Ship (LCS), a new Technology Transition Agreement (TTA) has been signed. This FNC program is in Phase II where large-scale prototype waterjets will be designed and fabricated for demonstration on the LCS. *FY 2008 Accomplishments:* - Continued work for a beachable high speed craft as a Sea Base mobility interface. - Continued efforts on the Large to Large Vessel Lift on/Lift off capability. - Continued technology exploration in hydrodynamic impacts and design space trade studies. - Continued efforts on the High Speed Sea Base to Shore Connector technology development. - Continued efforts to develop technologies for Small to Large At-Sea Vessel Interfaces. - Continued the development of concepts for High Rate Horizontal and Vertical Material Movement within the Sea Base. - Continued efforts to develop a large scale Axial Flow Waterjet technology with the new transition target to Littoral Combat Ship (LCS). - Continued efforts to develop blade control technology for the heavy lift vertical air replacement platform.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY			PROJECT NUMBER 2915	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2009 Plans: - Continue all efforts of FY 2008. - Complete efforts on the High Speed Sea Base to Shore Connector technology development through at-sea demonstrations of the technologies. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete efforts for Small-to-Large Vessel At-Sea Transfer development via an at-sea demonstration of the technology. - Complete efforts for High Rate Vertical / Horizontal Material Mover development via a large-scale demonstration of the technology. - Initiate efforts to develop large ship fuel savings technologies for high speed materiel transport ships and follow on efforts initiated under Friction Drag Reduction refocused to other FNC efforts.					
SEA BASE PLANNING, OPERATIONS AND LOGISTICS This activity includes support for Sea Base Integrated Operations; Surface Connector Vehicle Transfer; Automated Weapons Assembly; and Sense and Respond Logistics. 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. This activity further supports the Seabasing mission of marshalling troops, equipment, and materials. It will improve current replenishment capabilities for transfer of cargo between Sea Base/Logistics vessels (large ship-to-ship) during high sea states, while maintaining safety of operations. Technologies include optical recognition, advanced robotics for weapons assembly, integrated data architectures, high-strength composites, wear-resistant coatings, environmental sensing, ship-motion compensation for force control-based systems, intelligent systems, and robotics.		19.546	19.192	19.528	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	PROJECT NUMBER 2915

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2008 - FY 2010 funding profile reflects planned project transitions through land-based and at-sea demonstrations and also the effects of the realignment of FNC Program investments into Enabling Capabilities (ECs). *FY 2008 Accomplishments:* - Continued efforts on the Large to Large Vessel Lift on/Lift off capability. - Continued efforts in the development of Interface Ramp Technologies for seabasing. - Continued efforts in the development of Intra-Connector Material Handling cargo securing technologies. - Initiated efforts for the development of technologies supporting automated shipboard assembly of air-delivered weapons. - Initiated the development of advanced technologies to provide a Sense and Respond Logistics capability. *FY 2009 Plans:* - Continue all efforts of FY 2008. - Initiate efforts to develop Sense and Respond Logistics Information Architecture prototype. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete efforts for Intra-Connector Material Handling cargo securing technology development via an at-sea demonstration and transition to NAVSEA PMS 377. - Complete efforts on the Large to Large Vessel Interface Lift on/Lift off capability with post-test analyses and transition to NAVSEA PMS385. - Complete the down selection of the Sense and Respond Logistics Information Architecture. - Initiate efforts to demonstrate sensor based Sense and Respond Logistics advanced technologies. - Initiate procurement and testing of available microfiltration (MF), and ultrafiltration (UF), systems suitable for shipboard use. - Initiate investigation of seawater treatment strategies to optimize performance of MF/UF pretreatment approaches.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY			PROJECT NUMBER 2915	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate procurement and testing of approaches to recover energy from pressurized reverse osmosis waste brine. - Initiate efforts to select optimal reverse osmosis membranes. - Initiate development of agent based decision support and logistics planning tools.					
SEA BASING This activity includes advancement of technologies to support the design and development of Sea Base Enabler Innovative Naval Prototypes (INP's). Areas include design and development of various Sea Basing prototypes in the areas of high speed, shallow draft and beachable connectors; and vessel to vessel interfaces. The Sea Base Enabler INP effort was initiated in FY 2006. The INP program spans from conceptual design through prototype fabrication and testing. The increase between FY 2008 and FY 2009 represents changes in complexity and cost going from preliminary design and model development through prototype fabrication. This INP plan includes the completion of the development and at-sea testing of the Rapid Deployable Seabasing Stable Transfer Platform demonstrator; the continuation of several land based and tow-tank based model construction and testing for the Sea Base to “Over-the-Shore” Connector Transformational Craft (T-CRAFT) Prototype; and the full scale component-level development, evaluation, and testing of critical T-CRAFT technologies. The decrease in funding from FY 2009 to FY 2010 results from completion of test and evaluation of T-CRAFT model and down-selection. *FY 2008 Accomplishments:* - Continued multiple INP contracts for preliminary designs in the area of a T-CRAFT and a Rapidly Deployable Seabasing Stable Transfer Platform. - Continued the down-selection of T-CRAFT designs for further development and model construction and testing. - Continued T-CRAFT model construction and testing. - Continued a second evaluation of potential new Seabasing INP efforts. - Completed the development of the Rapidly Deployable Seabasing Stable Transfer Platform demonstrator.		12.051	26.154	13.825	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	PROJECT NUMBER 2915

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated planning of T-CRAFT prototype and component development. *FY 2009 Plans:* - Continue all efforts of FY 2008 less those noted as completed above. - Complete T-CRAFT model testing and evaluation. - Initiate the down-selection of T-CRAFT designs for prototype and component development. - Initiate testing and evaluation of E-CRAFT demonstrator hydrodynamic and structural characteristics. - Above Threshold Reprogramming (ATR) for RATTLRS for $18.789 was approved March 2009 to transfer to Program Element 0603114N (not reflected in current funding profile). *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete the down-selection of T-CRAFT designs for prototype and component development. - Complete testing and evaluation of E-CRAFT demonstrator hydrodynamic and structural characteristics. - Initiate contract design and develop shipyard building plans for T-CRAFT prototype and component construction. - Initiate procurement of components and material to support T-CRAFT prototype construction.				
TRAINING SYSTEMS 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. The decrease in funding from FY 2009 to FY 2010 results from completion of research to enhanced human performance in networked environments. *FY 2008 Accomplishments:* - Initiated research and assessment of advanced gaming technology for enhanced training.	9.749	10.737	8.790	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY			PROJECT NUMBER 2915	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated development and demonstration of technology for enhanced human performance in networked environments. - Initiated developments for enabling better warfighter understanding of languages and cultures to enhance their regional expertise. *FY 2009 Plans:* - Continue all efforts of FY 2008. - Initiate advanced technology development demonstrations of game based training for better warfighter understanding of languages and cultures to enhance their regional expertise. - Initiate experiments to validate automated performance assessment and after action reviews. - Initiate development of an Adaptive Expert System to automatically and rapidly analyze aircrew performance (1M+ flight hours annually) to detect human factors related mishap leading indicators using a new technique with anomaly and corroboration. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete development and demonstration of technology for enhanced human performance in networked environments. - Initiate development of validated, effective, adaptive training system components to enhance individual and team training for submarine navigation and piloting skills and for surface ship Combat Information Center training.					
TURBINE ENGINE TECHNOLOGY This activity provides integration and experimental engine testing of advanced gas turbine engine technologies to reduce their technical risk and demonstrate their readiness for transition. These technologies will enable advanced capabilities for Navy weapon systems at reduced total ownership costs. Versatile Affordable Advanced Turbine Engines (VAATE) is a DoD/DOE/NASA/Industry program to develop and demonstrate versatile, affordable, advanced engine technologies enabling for increased systems capabilities and reduced total ownership costs. The VAATE goal is 10X improvement in propulsion system affordability (capability/cost) by 2017, with interim goals of 4X by 2009 and 6X by		6.775	11.633	10.635	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	PROJECT NUMBER 2915

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
2013. The elements of the capability-to-cost index are increased thrust to weight; decreased specific fuel consumption; and reduced development, production, and maintenance costs for the entire integrated propulsion system. To achieve these goals, VAATE is organized into multiple product areas. Specifically for the Navy, the focus, as part of the Enterprise and Platform Enablers FNC, is on turbine engine capability enhancements for future and emerging systems. Technologies critical to Navy fighter jets are being worked, including low pressure turbine technologies for short takeoff and landing; high pressure turbine technologies for higher temperature, longer life; fan and compressor technologies for greater engine robustness and durability, and instrumentation and control technologies for greater engine state awareness and less unscheduled maintenance. Technologies being demonstrated include advanced aerodynamic, material, and structural concepts and emerging active control, prognostic health management, thermal management, aircraft subsystem integration, and information technologies. The increase in funding will support initiation of the design and fabrication of the VAATE II demonstrator engine with the General Electric (GE) / Liberty Works (LW) team that was delayed to FY 2009 and also the initiation of VAATE II demonstrator engine planning with Pratt and Whitney (P&W). *FY 2008 Accomplishments:* - Continued VAATE Phase I: Design, component development, integration and fabrication of Phase I demonstrator engines. - Completed initial testing of VAATE Phase I demonstrator and core engines with General Electric (GE)/ Liberty Works (LW) and Pratt & Whitney (P&W). - Initiated development of shipboard compact power conversion technologies for multi-function motor drives, bi-directional power conversion modules, and power management controllers. - Initiated design and fabrication of VAATE Phase II demonstrator engines with GE/LW and P&W. (Impact of Congressional reduction: Design and fabrication of VAATE Phase II demonstrator engines with GE/LW has been delayed until FY 2009.) *FY 2009 Plans:* - Continue all efforts of FY 2008 less those noted as completed above.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	PROJECT NUMBER 2915

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete reporting shipboard compact power conversion project under this Program Element (PE). These efforts transition to PE 0603123N Force Protection Advanced Technology, R2 Activity Surface Ship & Submarine Hull Mechanical and Electrical (HM&E) in FY 2009. - Complete testing of VAATE Phase I demonstrator engines with GE/LW and P&W. - Initiate component design and development for a VAATE Phase II demonstrator engine with P&W. - Initiate planning of a VAATE Phase II demonstrator engine planning with GE/LW. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. - Complete testing of the final VAATE Phase I demonstrator engine. - Initiate component design and development for a VAATE Phase II demonstrator engine with GE/LW.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	PROJECT NUMBER 2915

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0206624M/Marine Corps Combat Services Support									Continuing	Continuing
PE 0601102A/Defense Research Sciences									Continuing	Continuing
PE 0601102F/Defense Research Sciences									Continuing	Continuing
PE 0601103N/University Research Initiatives									Continuing	Continuing
PE 0601152N/In-House Laboratory Independent Research									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602123N/Force Protection Applied Research									Continuing	Continuing
PE 0602131M/Marine Corps Landing Force Technology									Continuing	Continuing
PE 0602203F/Aerospace Propulsion									Continuing	Continuing
PE 0602211A/Aviation Technology									Continuing	Continuing
PE 0602236N/Warfighter Sustainment Applied Research									Continuing	Continuing
									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603236N WARFIGHTER SUSTAINMENT ADVANCED TECHNOLOGY	PROJECT NUMBER 2915

PE 0603003A/Aviation Advanced Technology		
PE 0603007A/Manpower, Personnel and Training Advanced Technology	Continuing	Continuing
PE 0603216F/Aerospace Propulsion and Power Technology	Continuing	Continuing
PE 0603512N/Carrier Systems Development	Continuing	Continuing
PE 0603640M/USMC Advanced Technology Demonstration (ATD)	Continuing	Continuing
PE 0604703N/Personnel, Training, Simulation, and Human Factors	Continuing	Continuing
PE 0605013M/Information Technology Development	Continuing	Continuing
PE 0605152N/Studies and Analysis Support - Navy	Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Efforts within this PE support the FNC program and are monitored at two levels. At the lowest level, each is measured against technical and financial milestones on a monthly basis. Annually, each FNC project is reviewed in depth for technical and transition performance by The Chief of Naval Research. Routine site visits to performing organizations are conducted to assess programmatic and technical progress. Most are reviewed annually or bi-annually by an independent board of visitors who assess the level and quality of the Science and Technology basis for the project.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	43.599	55.866	65.827						Continuing	Continuing
2913: RF SYSTEMS ADVANCED TECHNOLOGY	25.272	36.918	65.827						Continuing	Continuing
9999: CONGRESSIONAL PLUS-UPS	18.327	18.948	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

Activities and efforts in this Program Element (PE) address technologies critical to enabling the transformation of discrete functions to network centric warfare capabilities which simultaneously perform Radar, Electronic Warfare (EW), and Communications and Network functions across platforms through multiple, simultaneous and continuous communications/data links. The Electromagnetic Systems Advanced Technology program addresses Radio Frequency (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 supporting the Future Naval Capabilities (FNC) Program Enabling Capabilities (ECs): Long Range Detection and Tracking, Advanced Electronic Sensor Systems for Missile Defense, SATCOM Vulnerability Mitigation; Affordable Common Radar Architecture, Next Generation Countermeasures Technologies for Ship Missile Defense, Next Generation Airborne Electronic Attack, Low Cost Over the Horizon Communication, Satellite Communication (SATCOM) and Line of Sight (LOS) Apertures, Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms, and Countermeasures Technologies for Anti-Ship Missile Defense (ASMD). Within the Naval Transformational Roadmap, this investment offers affordable options for the transformational capabilities required by the Sea Shield (Theater Air and Missile Defense), Sea Strike (Persistent Intelligence, Surveillance, and Reconnaissance), and ForceNet (Communications and Networking) SeaPower 21 Naval Warfighting Pillars.

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

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	41.204	37.058	59.356	
Current BES/President's Budget	43.599	55.866	65.827	
Total Adjustments	2.395	18.808	6.471	
Congressional Program Reductions		-0.191		
Congressional Rescissions				
Total Congressional Increases		19.000		
Total Reprogrammings	3.039			
SBIR/STTR Transfer	-0.644			
Program Adjustments			6.431	
Rate/Misc Adjustments		-0.001	0.040	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **C-BAND RADAR REPLACEMENT DEVELOPMENT**	3.868	3.989
Project: 9999, **PACIFIC AIRBORNE SURVEILLANCE AND TESTING**	14.459	14.959

Change Summary Explanation

Technical: FY 2010 reflects the realignment of the Global Positioning System (GPS) & Navigation Technology Activity from PE 0603235N because the technology development efforts are directly related to the current mission of this Program Element.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY					PROJECT NUMBER 2913	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
2913: RF SYSTEMS ADVANCED TECHNOLOGY	25.272	36.918	65.827						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project emphasizes near to mid-term transition opportunities by developing and demonstrating technologies which enable affordable options for transformational capabilities required by the Sea Shield, Sea Strike, and ForceNet pillars. Work in this project addresses cost-effective RF technology for Surface and Aerospace Surveillance sensors and systems, EW sensors and systems, RF Communication Systems, and Multi-Function sensor systems.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
ADVANCED MULTI-FUNCTION RF TECHNOLOGY	25.272	36.918	0.000	
This effort develops, demonstrates, and transitions affordable wideband, high performance Advanced Multifunction Radio Frequency (AMRF) apertures capable of transmitting and receiving multiple, simultaneous, independent RF beams while providing reduced signature and numbers of apertures. Program activity goals include development and demonstration of multi functional RF technologies applicable to systems development for Advanced Destroyers (DD(X)), Advanced Cruisers (CG(X)), Aircraft Carriers (CVNs), and other ship classes. These technologies 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; ability to upgrade systems and capabilities with reduced cost, time, and complexity while mitigating the risk of obsolescence; and ability to rapidly exploit technological innovation through open systems concepts. This activity also includes Multifunction Systems Technology developments that directly support the Department of Defense Joint Warfighter Science and Technology Plan and the Defense Technology Area Plans. The objective is as follows: Development of an affordable, open architecture Digital Array Radar for CG(X). Development, testing, and technology demonstration of communications, electronic attack, electronic surveillance, and radar				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY	PROJECT NUMBER 2913

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
functions in multi-function apertures. Development of a Multi Function Electronic Warfare/Electronic Surveillance (MFEW/ES) Advanced Development Model (ADM) architecture demonstrating key ES capabilities for several simultaneous ES functions and capable of supporting additional RF functions. Conducting MFEW/ES ADM testing that satisfies DD(X) acquisition 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. Electronic Attack (EA) Techniques maintain effective countermeasures in the face of increasingly sophisticated naval threats. The increase from FY 2008 to FY 2009 is due to initiation of Integrated Digital Apertures and Array Radar System (IDAARS) within the Integrated Topside (INTOP) Innovative Naval Prototype effort. *FY 2008 Accomplishments:* - Completed 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 Advanced Multifunction Radio Frequency- Concept (AMRF-C) effort. - Completed development of a High Band array antenna capable of simultaneously supporting multiple Electronic Support Measures (ESM) surveillance functions for the (MFEW/ES ADM) providing 4 high gain high sensitivity Electronics Support Measures beams. - Completed development of a Mid Band array antenna capable of simultaneously supporting multiple ESM functions for the MFEW/ES ADM. - Completed development of back-end analog receiver equipment supporting MFEW/ES ADM. - Completed 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. - Completed Shipboard EW Improvement and 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. Demonstrated capability to support 4 beams/band transmit functions.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY			PROJECT NUMBER 2913	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Completed the Shipboard Electro-Optical/Infra Red (EO/IR) Closed Loop Self-Protection effort by final at-sea demonstration of the Shipboard Integrated Electro-optic Defense System (SHIELDS) hardware which includes a Mid-Wave IR (MWIR) camera operating in the 2-5 um wavelength spectral band. - Initiated FNC EC Long Range Detection and Tracking. Captured and extended the prototype development that occurred under Advanced Electronic Sensor Systems for Missile Defense, this project delivers an affordable, open-architecture Digital Array Radar (DAR) single face Advanced Development Model (ADM). - Initiated the Next Generation Airborne Electronic Attack effort by performing a threat assessment study. - Initiated FNC Enabling Capability (EC) Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms. Developed Partial Array consisting of high efficiency non-commercial off-the-shelf (COTS) transmitter element chains using wide band-gap semiconductors, mixed signal digital, RF, microwave, millimeter wave and associated passive components, exploiting Development & Implementation (D&I) advances in high power, high efficiency digital S- and X-band microwave amplifiers to reduce cooling and prime power needs, enabling affordable radar and EA solutions for CG(X) and DD(X). Developed and demonstrated the technology for extending the digital domain further into the transmitter RF hardware, i.e., bringing the digital domain closer to the radiating element, enabling Navy systems to continue to exploit advancements in COTS computing capacity for signal generation and processing, and require the activity to only develop the combined RF/digital hardware. Targeted cost reductions to enable ubiquitous deployment of advanced radiating systems with affordable development and procurement costs. This EC takes the lead for development of efficient, high power RF digital-microwave transmitter technology by exploiting new technologies such as Wide Band Gap (WBG) semiconductors for substantial savings of prime power requirements and topside weight and moment. This provides a potential for smaller ships and reduced acquisition and life cycle costs. - Initiated H-60 Tactical Common Data Link (TCDL) project. - Initiated Low cost SATCOM-on-the-Move array for Marine Corps. - Initiated nested, coplanar array/ Modular Integrated Link Electronics System (MILES) design and integration.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY	PROJECT NUMBER 2913

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2009 Plans: In addition to being performed here in FY 2009, the following efforts transfer to the Integrated Topside (INTOP) Innovative Naval Prototype R2 Activity in FY 2010: - Initiate Integrated Digital Apertures and Array Radar System (IDAARS), a multi-function RF topside aperture prototype covering approximately 200MHz to 22 GHz and provide the appropriate control and synergy of the functionality such that the RF functions automatically support one another providing improved operational capability. Additionally, demonstrate reductions in size, weight, and power as well as cost (both acquisition and life cycle) by reducing the number of topside apertures needed for communication, electronic warfare, and some radar functions. A critical tenet of the prototype will be the demonstration of an open architecture so that not only can different companies supply the major components such as a given receive or transmit aperture, but even down to the subarray and lower component level throughout the life cycle to ensure continuing competition for maintenance and replacement parts. - Initiate technical studies of enabling radio frequency (RF) components for submarine Satellite Communications (SATCOM) arrays. (Which is a part of the above IDAARS effort.) - Initiate SATCOM Array technical designs. (Which is a part of the above IDAARS effort.) - Initiate studies for Electronic Attack (EA) design as follow-on to Multi-Function Electronic Warfare (MFEW) capability for forward-fit and back-fit. (Which is a part of the above IDAARS effort.) - Initiate development of architecture and interfaces and their application to wide-band SATCOM communications array for submarines. (Which is a part of the above IDAARS effort.) - Initiate development of functional queue management software. (Which is a part of the above IDAARS effort.) - Initiate development of control interface software for the resource allocation manager. (Which is a part of the above IDAARS effort.) In addition to being performed here in FY 2009, the following efforts transfer to the Electronic and Electromagnetic Systems R-2 Activity in FY 2010:				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY	PROJECT NUMBER 2913

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continue FNC EC Long Range Detection and Tracking. Capture and extend the prototype development that occurred under Advanced Electronic Sensor Systems for Missile Defense, this project delivers an affordable, open-architecture Digital Array Radar (DAR) single face Advanced Development Model (ADM). - Continue the Next Generation Airborne Electronic Attack. - Continue FNC EC Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms. Develop Partial Array consisting of high efficiency non-commercial off-the-shelf (COTS) transmitter element chains using wide band-gap semiconductors, mixed signal digital, RF, microwave, millimeter wave and associated passive components, exploiting Development & Implementation (D&I) advances in high power, high efficiency digital S- and X-band microwave amplifiers to reduce cooling and prime power needs, enabling affordable radar and EA solutions for CG(X) and DD(X). Develop and demonstrate the technology for extending the digital domain further into the transmitter RF hardware, i.e., bringing the digital domain closer to the radiating element, enabling Navy systems to continue to exploit advancements in COTS computing capacity for signal generation and processing, and require the activity to only develop the combined RF/digital hardware. Targeted cost reductions to enable ubiquitous deployment of advanced radiating systems with affordable development and procurement costs. This EC takes the lead for development of efficient, high power RF digital-microwave transmitter technology by exploiting new technologies such as Wide Band Gap (WBG) semiconductors for substantial savings of prime power requirements and topside weight and moment. This provides a potential for smaller ships and reduced acquisition and life cycle costs. - Continue H-60 Tactical Common Data Link (TCDL) project. - Continue Low cost SATCOM-on-the-Move array for Marine Corps. - Continue nested, coplanar array/ Modular Integrated Link Electronics System (MILES) design and integration. - Initiate the Affordable Common Radar Architecture (ACRA) effort by defining interface specifications. - Initiate the Enhanced Nulka Payload FNC effort by starting system architecture design. - Initiate the Enhanced Surface Electronic Warfare Improvement Program (SEWIP) Transmitter FNC effort by starting system architecture design and Low Voltage Gallium Arsenide (GaAs) High Power Amplifier (HPA) Monolithic Microwave Integrated Circuit (MMIC) purchases.				
ELECTRONIC AND ELECTROMAGNETIC SYSTEMS	0.000	0.000	33.105	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY	PROJECT NUMBER 2913

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
The overarching objective of this activity is to develop, test, and demonstrate communications, electronic attack (EA), electronic surveillance (ES), electronic warfare (EW), and radar functions. This activity also includes development of affordable wideband, high performance Advanced Multifunction Radio Frequency (AMRF) apertures. A portion of this PE is devoted to mid-term technology development in close concert with acquisition programs of record. The products of these efforts are expected to transition at the end of their schedule into the associated acquisition program of record. In this PE, these Future Naval Capability (FNC) Enabling Capabilities (ECs) span across Electronics, EW, Radar, and Communications technology areas. This activity also appears in PE 0602271N. For ECs receiving funding from both PE's, the PE 0602271N portion is generally focused on component design and development while the funding from this PE is focused on integration and demonstration. Effective FY 2010, resources and budget justification associated with the FNC ECs, formerly identified with the ADVANCED MULTI-FUNCTION RF TECHNOLOGY activity, are realigned into this activity. This realignment serves to better describe the full electromagnetic spectrum nature of the research initiatives and improve the tracking and justification of FNC initiatives within the budget submission. The major objectives of this activity are: a) Affordable Common Radar Architecture (ACRA) - Develop a scalable, open radar architecture that addresses affordability challenges for 5 different radars. b) Low Cost Over The Horizon (OTH) Communication, Satellite Communication (SATCOM) and Line Of Sight (LOS) Apertures - Provide a set of apertures, link electronics and programmable core terminal components that are suitable for multiple platforms. c) SATCOM Vulnerability Mitigation - Develop a diverse, multi-tier communications networking capability for Naval strike forces. d) Long Range Detection and Tracking - Ability to detect, track and identify (ID) future anti-ship ballistic missiles, advanced cruise missiles, aircraft and Unmanned Air Vehicles (UAVs).				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY	PROJECT NUMBER 2913

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
e) Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms - Develop and demonstrate affordable components in beamforming element chains for efficient S- and X-Band radar, and Electronic Attack (EA)using highly efficient digital solid state electronics components covering the RF and microwave frequencies. f) Countermeasure Technologies for Anti-Ship Missile Defense (ASMD) - Improve ship survivability by disrupting the terminal engagement phase of hostile Anti-Ship Cruise Missiles/ Anti-Ship Ballistic Missiles (ASCM/ASBM), including improvements to both onboard Surface Electronic Warfare Improvement Program (SEWIP) and offboard Nulka Radio Frequency (RF) Electronic Attack (EA) systems. g) Next Generation Countermeasure Technologies for Ship Missile Defense - Develop and demonstrate the fundamental technologies required to conduct next generation, persistent EW in support of ship, sea base, and littoral force missile defense operations in a distributed, coordinated manner across the entire battlespace. h) Next Generation Airborne Electronic Attack - Develop and demonstrate advanced capability Airborne Electronic Attack (AEA) sub-systems (e.g., broadband exciters, power amplifiers, and transmit arrays) that provide Suppression of Enemy Air Defenses (SEAD), deliver Non-Kinetic Fires, counter Integrated Air Defense Systems (IADS), and provide suppression of Command, Control & Communications (C3) links and data networks. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. *FY 2010 Plans:* Affordable Common Radar Architecture (ACRA): - Continue the Affordable Common Radar Architecture (ACRA) effort by defining interface specifications. This effort is developing a radar architecture which moves the digital conversions as close to the antenna as possible for substantial performance and supportability improvements.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY	PROJECT NUMBER 2913

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Low Cost Over The Horizon (OTH) Communication, Satellite Communication (SATCOM) and Line Of Sight (LOS) Apertures: - Continue H-60 Tactical Common Data Link (TCDL) project. This effort develops a scalable, low cost, light weight, low drag multichannel Jam Resistant (JR) Tactical Common Data Link (TCDL) relay and networking terminal. - Continue Low cost SATCOM-on-the-Move array for Marine Corps. This effort develops a low cost, scaleable Satellite Communication (SATCOM) on-the-move communication system for both High Data Rate (HDR) and Low Data Rate (LDR) Marine Corps vehicular communications. - Continue nested, coplanar array/ Modular Integrated Link Electronics System (MILES) design and integration. This effort develops a communications array which will provide UHF line of sight (LOS) functionality and Ku-Band communications for Naval Tactical Networking (NTN). SATCOM Vulnerability Mitigation: - Initiate development of hardware and software appliqués that implement waveforms, protocols, and techniques to significantly increase the data throughput on High Frequency (HF) communications channels. - Initiate development of multi-link, Ultra High Frequency (UHF), millimeter wave, air-to-air, air to ground and SATCOM terminals for networking airborne platforms with other airborne assets. Long Range Detection and Tracking: - Continue FNC EC Long Range Detection and Tracking. Capture and extend the prototype development that occurred under Advanced Electronic Sensor Systems for Missile Defense, this project delivers an affordable, open-architecture Digital Array Radar (DAR) single face Advanced Development Model (ADM). This effort demonstrates the ability to perform simultaneous full volume radar coverage of contacts at long ranges and in dense contact environments. Affordable Electronically Scanned Array Technology for Next Generation Naval Platforms:				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY			PROJECT NUMBER 2913	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continue to develop and demonstrate affordable components in beamforming element chains for efficient S- and X-Band radar, and Electronic Attack (EA)using highly efficient digital solid state electronics components covering the RF and microwave frequencies. Countermeasure Technologies for Anti-Ship Missile Defense (ASMD): - Continue the Enhanced Nulka Payload FNC effort by starting system architecture design. This effort develops an affordable and extremely compact RF payload for the NULKA offboard decoy with an Electronically Scanned Array (ESA) transmitter, compact receiver chain, and advanced isolation materials. - Continue the Enhanced Surface Electronic Warfare Improvement Program (SEWIP) Transmitter FNC effort by starting system architecture design and Low Voltage Gallium Arsenide (GaAs) High Power Amplifier (HPA) Monolithic Microwave Integrated Circuit (MMIC) purchases. This effort develops affordable and reliable solid state transmitter technologies to engage anti-ship cruise and ballistic missile RF seekers. Next Generation Countermeasure Technologies for Ship Missile Defense: - Continue the development of technologies to demonstrate effective Electronic Warfare (EW) countermeasures for ship missile defense operations in a distributed coordinated manner across the entire battlespace. Next Generation Airborne Electronic Attack: - Continue the Next Generation Airborne Electronic Attack FNC effort by demonstrating critical sub-systems operating in the RF low- and mid-bands. This effort develops and demonstrates advanced capability Airborne Electronic Attack (AEA) sub-systems (e.g., broadband exciters, power amplifiers, and transmit arrays) that provide suppression of enemy air defenses (SEAD), deliver non-kinetic fires, counter integrated air defense systems (IADS), and provide suppression of Command, Control & Communications (C3) links and data networks.					
GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY		0.000	0.000	4.554	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY	PROJECT NUMBER 2913

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
The overarching objective of this activity is to develop technologies that enable the development of affordable, effective and robust Position, Navigation and Timing (PNT) capabilities using either GPS systems, non-GPS navigation devices, or atomic clocks. This activity will increase the operational effectiveness of U.S. Naval units. The focus is on the mitigation of GPS electronic threats, the development of atomic clocks that possess unique long-term stability and precision, and the development of compact, low-cost, Inertial Navigation Systems (INS). Efforts identified in this R2 activity transfer from PE 0603235N in FY 2010. The major objectives of this activity are: a) GPS Anti-Jam Antennas and Receivers - Integrate and demonstrate anti-jam antennas and antenna electronics for Navy platforms for the purpose of providing precision navigation capabilities in the presence of electronic threats; to integrate and demonstrate anti-spoofer/anti-jam processors for the purpose of providing precision navigation capabilities in the presence of emergent threats. b) Precision Time and Time Transfer - Integrate and demonstrate tactical grade atomic clocks that possess unique long-term stability and precision for the purpose of providing GPS-independent precision time; to integrate and demonstrate the capability of transferring GPS-derived time via radio frequency links for the purpose of providing GPS-independent precision time. c) Non-GPS Navigation Technology - To integrate and demonstrate inertial navigation systems for the purpose of providing an alternative means of providing precision navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals; to integrate and demonstrate a correlation navigation technique using earth maps of high precision (including bathymetric, magnetic and gravimetric data) for navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals. The following are non-inclusive examples for projects funded in this activity.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY	PROJECT NUMBER 2913

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2010 Plans: GPS Anti-Jam Antennas and Receivers: - Continue the Adaptive Temporal Suppression of GPS Structured Interference project. - Continue the GPS anti-spoofer antenna electronics effort using Electronic Support Measures (ESM) and tracking/location-based system. Precision Time and Time Transfer: - Continue the development of algorithms for distributed time 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). Non-GPS Navigation Technology: - Continue the development of a small, lightweight Micro-Electro-Mechanical Systems (MEMS) Accelerometer for navigation systems; and fabricated an Electro-Optic Accelerometer. - Continue the 5-cc accelerometer with the Embedded GPS Inertial (EGI) System for aircraft avionics applications. - Continue the MEMS Gyro-cluster INS for Tactical Platforms project. - Continue the Precision Celestial Navigation System (PCNS) project. - Continue the Dead Reckoning Advanced Tight Coupling (DRATC) project. - Continue the navigation grade Inertial Navigation System (INS) using fiber optic/Micro-Electronic Mechanical System (MEMS) gyros and electro-optic accelerometers. - Initiate the development of the Sonar Aided Bathymetric Navigation Technology. - Initiate the Optically Transduced MEMS Inertial Navigation System project. - Initiate the Sub-harmonic Lateral Mode MEMS Inertial Navigation System project. - Initiate the Two-Axis Gyro-compass Fiber Optic Inertial Navigation System project.				
INTEGRATED TOPSIDE (INTOP) INNOVATIVE NAVAL PROTOTYPE (INP) The overarching objective of the Integrated Topside (INTOP) Innovative Naval Prototype (INP) is to develop and demonstrate a prototype that integrates RF functions (EW, Radar, Communications,	0.000	0.000	28.168	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY	PROJECT NUMBER 2913

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Navigation) into a common set of multi-function apertures through an architecture that is modular, scalable across all platforms, and open at the RF as well as computer and software level. The apertures are capable of providing multiple simultaneous, independent beams any one of which can perform any of the above functions. Effective FY 2010, resources and budget justification associated with Integrated Topside (INTOP) formerly referred to as Integrated Digital Apertures and Array Radar System (IDAARS) effort are realigned from the activity titled ADVANCED MULTI-FUNCTION RF TECHNOLOGY. This realignment allows for improved description of the critical and unique application of technology, program technical initiatives, and associated resources within the INP program. IDAARS commenced in FY 2009. The major objectives of this activity are: a) Submarine Satellite Communication (SATCOM) Array - Develop wide-band SATCOM array capable of supporting Electronic Warfare (EW) for submarines. b) Electronic Attack for Surface Combatants - Develop wide-band transmit array to support Electronic Attack (EA) capability and other functions for surface combatants with potential application to other platforms. c) Architecture, Standards and Devices - Develop architecture and standards for wide-band multi-beam, multi-band arrays and below deck systems and the technology and electronic devices needed to make integrated array systems affordable. d) Surface Combatant Communication Array - Develop wide-band surface combatant communication array capable of supporting other RF functions. e) Resource Allocation Manager - Develop enterprise common Resource Allocation Manager.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY			PROJECT NUMBER 2913	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

f) Joint Counter Radio Controlled Improvised Explosive Device Electronic Warfare (JCREW) 3 - Develop integrated RF communications and RF jammer capability that addresses electromagnetic interference (EMI) issue to enable interoperability.

The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.

FY 2010 Plans:

Submarine SATCOM Array:
- Complete technical studies of enabling radio frequency (RF) components for submarine Satellite Communication (SATCOM) arrays.
- Continue SATCOM Array technical designs.
- Initiate prototype array development.

Electronic Attack for Surface Combatants:
- Complete studies for Electronic Attack (EA) design as follow-on to Multi-Function Electronic Warfare (MFEW) capability for forward-fit and back-fit.
- Initiate design of EA capability.

Architecture, Standards and Devices:
- Continue Integrated Digital Apertures and Array Radar System (IDAARS), a multi-function RF topside aperture prototype covering approximately 200MHz to 22 GHz and provide the appropriate control and synergy of the functionality such that the RF functions automatically support one another providing improved operational capability. Additionally, demonstrate reductions in size, weight, and power as well as cost (both acquisition and life cycle) by reducing the number of topside apertures needed for communication, electronic warfare, and some radar functions. A critical tenet of the prototype will be the demonstration of an open architecture so that not only can different companies supply the major components such as a given receive or transmit aperture, but even down to the subarray and lower component level throughout the life cycle to ensure continuing competition for maintenance and replacement parts.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification			DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY		PROJECT NUMBER 2913	
B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continue development of architecture and interfaces and their application to wide-band SATCOM arrays for submarines. - Initiate development of deckhouse and platform integration strategies and concepts. Surface Combatants Communications Array: - Initiate studies of array concepts. Resource Allocation Manager: - Continue development of functional queue management software. - Continue development of control interface software for the resource allocation manager.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY	PROJECT NUMBER 2913

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0204152N/E-2 Squadrons									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602123N/Force Protection Applied Research									Continuing	Continuing
PE 0602131M/Marine Corps Landing Force Technology									Continuing	Continuing
PE 0602235N/Common Picture Applied Research									Continuing	Continuing
PE 0602271N/ Electromagnetic Systems Applied Research									Continuing	Continuing
PE 0603123N/Force Protection Advanced Technology									Continuing	Continuing
PE 0603235N/Common Picture Advanced Technology									Continuing	Continuing
PE 0603640M/USMC Advanced Technology Demonstration (ATD)									Continuing	Continuing
PE 0604307N/Surface Combatant Combat System Engineering									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603271N ELECTROMAGNETIC SYSTEMS ADVANCED TECHNOLOGY	PROJECT NUMBER 2913

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Advanced Electronic Sensor Systems for Missile Defense and Long Range Detection and Tracking ECs are aligned to the Navy's Advanced Cruiser (CG(X)) plans and closely coordinated with Naval Sea Systems Command Integrated Warfare Systems (PEO IWS 2.0). Other performance metrics are discussed within the R-2a.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	90.671	103.296	107.363						Continuing	Continuing
2223: MARINE CORPS ATD	45.979	59.166	70.743						Continuing	Continuing
2297: CMC WARFIGHTING LAB CORE	37.172	36.271	36.620						Continuing	Continuing
9999: CONGRESSIONAL PLUS-UPS	7.520	7.859	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval Science and Technology (S&T) Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential S&T efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

As a key component of naval expeditionary forces, the Marine Corps has unique and technologically stressing requirements because of its expeditionary mission and intensive operational tempo, Marine Air-Ground Task Force (MAGTF) structure, and conduct of maneuver warfare. Critical requirements in this program element (PE) are: Command, Control, Communications, Computers (C4), Intelligence, Surveillance, and Reconnaissance (ISR); maneuver techniques and means; force protection; logistic sustainment; human performance, training and education; and firepower. There are ongoing actions to develop and demonstrate advanced technologies and concepts in operational environments. Joint service efforts are aligned with Defense Technology Objectives and Joint Warfighting Capability Objectives. In addition, there is funding for experimentation in warfighting concepts as well as operational assessment of emerging technologies, to include technical support of operating forces to assess military utility of selected technologies. This PE specifically supports: continued development of Distributed Operations (DO) through field experiments with Marine infantry battalions; rapid response to low-, mid-, and high-intensity conflicts in the Overseas Contingency Operation (OCO); methods for countering irregular threats; and expansion of seabasing and naval force packaging capabilities. The investment directly assists in fulfilling the forward presence requirements of Sea Shield and the transformational capabilities prescribed by Sea Strike. The Future Naval Capability (FNC) process is supported and funds are programmed accordingly. This PE is largely focused on demonstration of products and capabilities from the knowledge base and Discovery

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)

and Invention (D&I) phases of Naval Science and Technology (S&T). As Naval partners, the Navy and Marine Corps S&T Team strive to transition technologies that will implement objectives outlined in the Naval Operations Concept. This PE also funds technical solutions designed to increase Naval force capability, such as the Naval Expeditionary Combat Command. Investments in S&T provide the opportunities for future capabilities and will prevent technological surprise. The PE as a whole will advance the amphibious and expeditionary capabilities for the Combatant Commanders helping to meet their emerging challenges by enhancing Naval S&T contributions to the long commitment to the OCO.

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

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	77.760	100.787	107.461	
Current BES/President's Budget	90.671	103.296	107.363	
Total Adjustments	12.911	2.509	-0.098	
Congressional Program Reductions		-5.334		
Congressional Rescissions				
Total Congressional Increases		7.880		
Total Reprogrammings	-2.000			
SBIR/STTR Transfer	-0.755			
Net OCO Supplemental	15.666			
Program Adjustments			-0.161	
Rate/Misc Adjustments		-0.037	0.063	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **BALLISTIC HELMET DEVELOPMENT**	0.000	1.197
Project: 9999, **CRAFT INTEGRATED ELECTRONIC SUITE (CIES)**	2.313	2.872
Project: 9999, **DUAL STAGE ULTRA RELIABLE WATER FILTRATION TECHNOLOGY DEVELOPMENT**	1.928	0.000
Project: 9999, **GROUND WARFARE ACOUSTICAL COMBAT SYSTEM OF NETTED SENSORS**	0.000	1.995
Project: 9999, **MARINE AIR-GROUND TASK FORCE SITUATIONAL AWARENESS**	0.965	0.997
Project: 9999, **MEMS MICRODETONATOR PACKAGING TECHNOLOGY**	2.314	0.000
Project: 9999, **NEAR INFRARED OPTICAL (NIRO) AUGMENTATION SYSTEM**	0.000	0.798

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)

Change Summary Explanation

Technical: FY 2009 reflects funding for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. DoD directed this initiative in response to the determination that its S&T investment is likely too small to meet the imposing security threats that challenge our Nation, and it may not be adequately postured to take advantage of key scientific and technological opportunities that offer breakthrough advantages to our warfighters. This broad, multi-year (through the FYDP) initiative will expand existing technology integration and increase/spur the application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes; therefore, funding associated with this DoD initiative is reflected throughout the PE. In FY 2010 preparation efforts continue in areas of technology that are ready for major, integrated technology demonstration. All technical work is being coordinated throughout DoD on these demonstrations. In areas such as vehicle technology demonstrations, the goal is to deliver multiple classes of advanced technology ground vehicle demonstrations leading to new classes of protective, efficient, ground vehicles.

Schedule: Project 2297, Worldwide contingency and combat operations (i.e. Operation Iraqi Freedom (OIF) campaigns, humanitarian efforts, and others) have increased the operations tempo of United States Operating Forces to the extent that their support of and participation in the Marine Corps Warfighting Laboratory (MCWL) Advanced Warfighting Experiments (AWEs) Sea Viking (SV) 2004, 2006, and 2008 was/remains substantially reduced. Events are 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.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)					PROJECT NUMBER 2223	
COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
2223: MARINE CORPS ATD	45.979	59.166	70.743						Continuing	Continuing

A. Mission Description and Budget Item Justification

Critical Marine Corps requirements/imperatives addressed in this Project are: Maneuver; Force Protection; Human Performance, Training and Education; Logistics; Command, Control, Communications and Computers (C4); Intelligence, Surveillance and Reconnaissance (ISR) 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 prototyped to reduce risk in System Concept Development and Demonstration. A tactically effective Mine Countermeasures (MCM) capability is vital to Force Protection and necessary if Maneuver on land is to become a functional component of Naval Expeditionary Maneuver Warfare. 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 Military Operations in Urban Terrain (MOUT), and in Operations other than War (OOTW); and 3) 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 related Enabling Capability (EC) within the Future Naval Capabilities (FNC) portfolio. The focus of the EC within this PE is 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 and is one of the highest ranked Capability Gaps prioritized by the Chief of Naval Operations and the Marine Corps Combat Development Command (MCCDC). The UAEO technology gap is being pursued as part of an overall effort that addresses the Sea Strike Capability Gap.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS (C4)	0.000	3.740	6.016	
This activity integrates and demonstrates enhanced communications and situational awareness in warfighting environments and communication and situational awareness technologies for near term USMC operations. The focus is on development and leveraging advanced C4 technologies to enable enhanced Distributed Operations, Irregular Warfare, and Marine Corps Expeditionary Warfare. Specifically, the C4 Thrust intends to demonstrate markedly improved capabilities in over-the-horizon (OTH), beyond line-of-				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2223	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

sight, and restricted environment communications; mobile networking; tactical decision making; tactical situational awareness; and small unit position location and navigation. Advanced technology resources will be applied to complement commercial, other service, and defense agency investments to produce a technology base to address identified Marine Corps technology gaps.

In FY 2008, this effort was funded in the C4ISR activity within this PE.

FY 2009 reflects a funding increase for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for:
- Pre-detonation of IEDs;
- Personal protection materials;
- Personal power generation;
- Micro power sources; and
- Augmented reality.

The C4 activity directly supports the integrated demonstration program, which will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes.

The FY 2009 to FY 2010 increase in funding is due to acceleration of the schedule of the Software Reprogrammable Payload and Satellite Communications On-The-Move Integration efforts in order to meet transition milestones. The FY 2010 resources complete the SRP program S&T and enables transition the capability to 6.4. SRP is a high priority Navy/MC Aviation program that will enable on-the-fly reconfigurable, multiple, simultaneous missions and applications in a single payload. Navy will deliver an integrated hardware prototype, software, firmware, and supporting documentation to the transition sponsor (Navy/MC Aviation).

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2223	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2009 Plans: - Continue urban navigation with limited Global Positioning System availability demonstrations. (Realigned from C4ISR Activity) - Continue demonstrations of improved urban communications capabilities. (Realigned from C4ISR Activity) - Continue creating a service oriented sensor network for expeditionary forces' current and future tactical sensors. (Realigned from C4ISR Activity) - Continue developing tailored tactical Human to Machine Interfaces aligned to primary operational functions and non-intrusive within the battlespace. (Realigned from C4ISR Activity) - Continue creating services for the tactical network that are fully operable with DCGS and the DCGS Integration Backbone. (Realigned from C4ISR Activity) - Complete conformal antenna integration and demonstrations. (Realigned from C4ISR Activity) - Initiate an Assured Connectivity effort to develop waveforms suited to maintaining low data rate links under extreme conditions. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete Common Operational Picture Fusion Tools efforts, Software Reprogrammable Payload, Satellite Communications On-The-Move integration and demonstration, and C3 for the Individual Marine Spiral One.					
COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, AND INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE (C4ISR) 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 2009 reflects both Command, Control, Communications, Computers (C4) and Intelligence, Surveillance and Reconnaissance (ISR) efforts and funding now being placed into separate activities within this PE.		5.161	0.000	0.000	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2223

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2008 Accomplishments: - Continued integration and demonstration of naval tactical warfighting applications and network connectivity. - Continued development and demonstration of low-cost compact conformal antenna capability. - Continued development and demonstration of urban communications capability. - Continued efforts to reduce the risk in investing in the ability to see through urban structures in an effort to identify enemy personnel or other assets. - Continued designing tools for mission specific tactical sensor fields capable of fulfilling specific mission objectives. - Continued developing smart tactical sensors, platforms and algorithms capable of forwarding information/knowledge vice raw data. - Continued creating a service oriented sensor network for expeditionary forces' current and future tactical sensors. - Continued creating fusion tools capable of translating tactical sensor data into appropriate situational awareness for expeditionary forces in near real-time. - Continued designing autonomous platforms and automatic sensor planning and management tools to ensure that the right data is collected by the right sensor in support of intelligence requirements. -Continued developing tailored tactical Human to Machine Interfaces aligned to primary operational functions and non-intrusive within the battlespace. - Continued creating services for the tactical network that are fully operable with DCGS and the DCGS Integration Backbone. - Continued development and demonstration of measurement and signature intelligence data management and integration capability. - Continued demonstrations of tagging, tracking and locating various adversarial targets. - Continued development of adaptable enemy course of action engine (smart algorithms) development to interfere with or influence adversarial plans. - Completed efforts to reduce the risk in investing in the ability to see through urban structures in an effort to identify enemy personnel or other assets. - Initiated demonstrations of improved urban communications capabilities. - Initiated urban navigation with limited Global Positioning System availability demonstrations.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2223	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated development of advanced tactical sensor nets that will localize mobile detection of threats.					
FIREPOWER 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 2009 reflects an increase for emerging priority requirements in lightening the load of the individual Marine while simultaneously enhancing the combat capabilities of the Marine Corps Rifle Squad and for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for: - Pre-detonation of IEDs; - Personal protection materials; - Personal power generation; - Micro power sources; and - Augmented reality. The Firepower activity directly supports the integrated demonstration program, which will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. The FY 2009 to FY 2010 funding decrease results from earlier than planned completion of research on Lightweight Machine Gun Barrel technology. *FY 2008 Accomplishments:* - Continued scalable effects conventional warhead concept development.		3.147	6.167	5.980	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2223	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

- Continued shipboard submunition Microelectromechanical System (MEMS) fuze safety and reliability enhancement effort from PE 0602131M.
- Continued MACHSI advanced technology development.
- Continued enhanced lethality and extended range ammunition demonstrations.
- Completed development of caseless small caliber ammunition.
- Initiated improved mortar munition integration and demonstrations.
- Initiated development of targeting and engagement technologies for distributed operations collaborative fires integration and demonstrations.
- Initiated a Wind Sensing Program to provide technology that senses wind velocity & direction at firing point to apogee and supporting algorithms to compensate the computed/predicted wind effects on the ballistic flight of the 81mm mortar round in order to enhance weapon accuracy.

FY 2009 Plans:
- Continue all efforts of FY 2008, less those noted as completed above.
- Complete shipboard submunition MEMS fuze safety and reliability enhancement effort.
- Complete enhanced lethality and extended range ammunition demonstrations.
- Initiate an effort in Ballistic Flight Compensation Aiming in support of Distributed Operations Precision Engagement.
- Initiate design and prototyping of lightweight technologies that provide individual Marines enhanced capabilities to detect and identify man-size targets out to at least the maximum effective range of their personal weapons during all conditions (daylight, limited visibility, & darkness) by integrating multiple capabilities into a single system.
- Initiate a Flight Control Kinematic Unit effort. Design & develop technology that provides guidance, navigation, and controls (GNC) to 81mm mortar rounds to enable trajectory shaping in urban environment to precisely & accurately strike specific targets.

FY 2010 Plans:
- Continue all efforts of FY 2009, less those noted as completed above.
- Complete research on Lightweight Machine Gun Barrel technology to develop a lighter weight machine gun barrel with longer service life. (Relates to the FY 2009 Flight Control Kinematic Unit effort).

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2223

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FORCE PROTECTION	0.000	6.192	7.093	

This activity supports the Force Protection Thrust's Advanced Technology Demonstration efforts in the areas of individual Marine platforms, equipment and autonomous systems. This includes technologies to enable detection, neutralization, breaching, and clearing of mines, Improvised Explosive Devices (IEDs), and unexploded ordnance from the beach exit to inland objectives. Efforts supported under Force Protection also include the demonstration of technologies such as Counter Rocket, Artillery, and Mortar (CRAM) and Counter Sniper technologies in support of maneuver warfare, small unit distributed operations, and fixed installation protection and technologies for improved Personnel Protective Equipment for individual protection against blast, ballistic, and blunt impact threats as well as in a chemical, radiological, and biological environment. Physical Security technologies to support expeditionary maneuver warfare, pier/port and base infrastructure are also addressed under this thrust. Beginning in FY 2009, Mine Countermeasures (MCM) efforts will be funded within the Force Protection activity. FY 2009 is the first reporting cycle where Force Protection Thrust efforts are separated from the Maneuver activity. Counter–IED and Counter–RPG Technologies remain high priority Marine Corps focal areas.

FY 2009 reflects additional funding for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for:
- Pre-detonation of IEDs;
- Personal protection materials;
- Personal power generation;
- Micro power sources; and
- Augmented reality.

The Force Protection activity is central to the integrated demonstration program, which will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2223	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2009 Plans: - Continue development of technologies to defeat side/top attack and advanced fuze mines through signature reduction and advanced signature duplication. - Continue development of technologies to locate and defeat IEDs. - Continue development of technologies to defeat advanced mine fuzes (seismic, acoustic, and infrared). - Continue efforts to detect IEDs using radio frequency sources. - Continue technology development programs to address force protection capability gaps. - Complete studies to identify technology development plans and develop roadmaps to close identified force protection capability gaps. - Complete design of a novel low passive inter-modulation wideband antenna for use against multiple classes of radio frequency triggered IEDs. - Complete investigation of polarization diversity designs to counter specific placements and orientations of radio frequency triggered IEDs. - Initiate new Explosives Hazard Defeat to address the Suicide-Bomber threat. This effort will combine multiple sensor modalities, analysis algorithms, and data fusion to demonstrate high Pd, low FAR detection of suicide bombers from standoff distances from multiple aspect angles. - Initiate a new Anti-Tank Guided Missile (ATGM) effort to defeat ATGMs in complex urban environment. - Initiate Warfighter modeling and simulation efforts for the Warfighter-as-a-System analysis approach and methodology combining survivability, mobility, and warfighter performance parameters. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. - Complete advanced countermeasures technology development against magnetic fuzed landmines. - Complete development of point detection of explosives associated with IEDs. (Relates to the FY 2009 plan to detect IEDs using radio frequency sources). - Initiate high-power solid state source development for IED neutralization. - Initiate vulnerability assessment of threat targeting sensors to directed energy.					
HUMAN PERFORMANCE, TRAINING & EDUCATION		3.036	7.504	9.230	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2223

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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 2009 reflects an increase for enhanced requirements in support of Distributed Operations and for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for: - Pre-detonation of IEDs; - Personal protection materials; - Personal power generation; - Micro power sources; and - Augmented reality. The Human Performance, Training and Education activity is key to the integrated demonstration program, which will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. The FY 2009 to FY 2010 funding increase is due to enhanced development of early prototype systems for Human Performance and Training efforts (Cognitive and physical enhancement, modeling and simulation, and virtual reality and mixed reality squad level training in support of the Marine Corps concept for Distributed Operations). *FY 2008 Accomplishments:* - Continued the development of tools to capture metrics and lessons learned from a variety of simulation and training sources.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2223	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Continued Marine Advanced Combat Headborne Initiative (MACHSI): physical protection of the head, neck and face. (Transitioned from the Firepower activity.) - Continued development of the Distributed Operations Training/Virtual Test Bed. - Continued research into environmental effects on cognitive and team performance. - Completed research into augmented reality training systems to enhance warfighter performance in urban combat. - Completed integration of cognitive performance improvement (augmented cognition) technology using operationally relevant systems and scenarios, and demonstrate improved human cognition via multiple sensory modalities. - Completed development of immersive closed loop training system for MOUT. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Initiate development of adaptive experiential learning tools for Distributed Operations Training. - Initiate in-depth analysis, state-of-the-art report, and testing on all USMC physical training regimens, their effectiveness and their injury incidence rates. - Initiate development of “Warfighter as a System” modeling tools. - Initiate development of automated behavioral and neurophysiological performance measurement technologies for Distributed Operations Warfighter assessment, classification and assignment to training. - Initiate Human Performance and Training capabilities (Cognitive and physical enhancement, modeling and simulation, virtual reality squad level training) in support of Distributed Operations. - Initiate demonstrations and field studies of mitigation/augmentation capabilities that enhance squad level communication in support of Distributed Operations. - Initiate development of a Distributed Operations virtual reality simulation training system prototype that will be scalable across fire team, squad, and platoon. - Initiate Lightening the Load efforts aimed at developing the software necessary to conduct trade off analysis on a physically and ergonomically accurate model of the United States Marine and its infantry equipment. - Initiate new Experiential Learning Technologies to improve the Infantry Immersive Trainer to support the Squad Immersive Training Environment (SITE) Marine Corps Urgent Needs Statement. This includes					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2223	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
developing tracking, Helmet Mounted Displays, and software technologies to enable Augmented Reality in unimproved locations. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Initiate evaluations and validations of applications geared towards peak neural and cognitive performance-in distributed operations. - Initiate Distributed Operations training system investigations into perceptual skills enhancement that lead to enhanced cognition and decision making. - Initiate development of early prototype systems for Human Performance and Training efforts (Cognitive and physical enhancement, modeling and simulation, and virtual reality and mixed reality squad level training in support of Distributed Operations).					
INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR) This activity supports the demonstration of technologies to enhance situational awareness and tactical decision making through automated analysis, fusion of data, rapid integration of information, and acquired knowledge resulting in actionable intelligence at the lower command levels. The activity includes the demonstration of ISR efforts involving enhanced reconnaissance and persistent surveillance, and sensors for unmanned ground and aerial vehicles. Advanced Technology demonstrations also include the collection of information [monitoring, sensing, and locating] in the 3D urban battlespace as well as exploiting information [identifying and classifying data] as part of the intelligence preparation of the battlespace in order to facilitate operational maneuver and distributed operations. In FY 2008, this effort was funded in the C4ISR activity within this PE. FY 2009 reflects an increase for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for: - Pre-detonation of IEDs; - Personal protection materials;		0.000	2.351	3.140	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2223	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

- Personal power generation;
- Micro power sources; and
- Augmented reality.

The ISR activity directly supports the integrated demonstration program, which will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes.

The FY 2009 to FY 2010 funding increase is due to planned acceleration of work to refine enemy course of action prediction software to adapt to stimuli.

FY 2009 Plans:

- Continue development of advanced tactical sensor nets that localize mobile detection of threats in a complex environment. (Realigned from C4ISR Activity)
- Continue development and demonstration of measurement and signature intelligence data management and integration capability. (Realigned from C4ISR Activity)
- Continue integration and demonstration of naval tactical warfighting applications and network connectivity.
- Continue tagging, tracking, and locating efforts to demonstrate the effectiveness of tactically relevant tag readers which support track classification algorithms. (Realigned from C4ISR Activity)
- Continue efforts to refine enemy course of action prediction software to adapt to stimuli. (Realigned from C4ISR Activity)
- Continue and initiate new Actionable Intelligence for Expeditionary and Irregular Warfare efforts which include Human Network Decision Modeling and the fusion across modeling approaches to increase prediction accuracy. (Realigned from C4ISR Activity)
- Initiate development of tactical sensor nets with organic unattended multi-level security processing and information dissemination.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2223	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate new Relevant and Situational Information on Demand such as Identity Dominance Enabled by an Integrated Biometric/Tag Track and Locate (TTL) Capability, providing human tracking algorithms based on models of biometric (face, voice and soft) and TTL (optical taggant) capabilities and modeling a biometric/optical taggant system relevant to human tracking across an urban 5 km x 2 km area. - Initiate new Sensor Fields efforts such as Nanotechnology Enabled Witness Fields, development of sensors that provide near real time decision support to distributed operations by detecting specific interactions, and nanotechnology efforts which offer the potential to revolutionize tactical sensors. To enable this capability, nanomaterials that change state in the presence of another nanomaterial will be developed. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Complete efforts to refine enemy course of action prediction software to adapt to stimuli. - Initiate tagging, tracking, and locating efforts to demonstrate a system that will automatically translate large amounts of wide area surveillance data into tracks, useful to expose entity to entity associations; build urban context, as well as detect events and anomalies; and associate objects, tasks, locations and events for creating actionable intelligence. - Initiate algorithm development for base classification on context, similarity to clutter, and nearness to suspicion. - Initiate efforts to analyze and expose enemy networks using close observations of entity to entity associations and social network analysis. - Initiate efforts to develop methods and techniques for investigating open source information on the Internet to form a human terrain map indicating space and time features to aid network identification and prediction of enemy activity. - Initiate efforts to incorporate social models for human decision making with statistical models.					
LITTORAL COMBAT/POWER PROJECTION (LC/PP) This activity is aligned with the Sea Strike, Sea Shield, Sea Basing and FORCEnet pillars and provides the capability for the demonstration and transition of technologies developed through the related Marine		14.480	16.675	17.111	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2223	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

Corps S&T programs directly to an acquisition program of record. Littoral Combat/Power Projection is the Enabling Capability (EC).

The funding profile reflects the alignment of the FNC program investments into ECs. Funding for each EC is aligned to a 6.2 or 6.3 Budget Activity (BA) as appropriate. The focus of the ECs within this PE will be on technology related to Urban, Asymmetric, Littoral and Expeditionary Operations. The related science and technology development is of the highest importance to Marine Corps operations in Iraq, Afghanistan and the OCO. Understandably, these Warfighter Capability Gaps are among those highest ranked of the prioritized Capability Gaps (prioritized by the OPNAV and the MCCDC). The technologies associated with these gaps are being pursued as part of an overall effort that addresses Sea Strike, Sea Shield, Sea Basing and FORCEnet Capability Gaps. Warfighter Capability Gaps are made up of ECs and supporting products. This activity includes support to the Urban, Asymmetric Operations-related to EC's for IED's, Modular Scalable Effects Weapons, Advanced Naval Fires Technology, Dynamic Target Engagement, Position Location Information, Transparent Urban Structures, Hostile Fire Detection and Response, Lightweight Protective Systems, and Lightening the Load of Dismounted Combatants.

FY 2008 Accomplishments:

- Continued development of tools and technologies to support Marine Corps Intelligence, Surveillance and Reconnaissance (ISR) efforts Measurement and Signature Intelligence Tactical Remote Sensor System (MASINT/TRSS) in remote sensor integration within the Distributed Common Ground/Surface System (DCGS).
- Continued 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. (Concurrent funding in PE 0602131M and 0602236N)
- Continued development of improved lightweight computational fire control interface technology. (Concurrent funding from PE 0602131M, 0602236N, 0603236N and 0603782N)
- Continued development of improved fire control systems technologies to Expeditionary Fire Support System artillery and mortar systems.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2223

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued effort to incorporate advanced target acquisition target hand-off technologies to reduce sensor to shooter loop and improve target location. (Concurrent effort funded in PE 0602131M). - Continued development of ammunition packaging techniques to lower weight and have the packaging provide additional use on the battlefield. (Concurrent funding provided by PE 0602131M). - Continued integration of hostile fire detection and counter-fire system (GUNSLINGER). (Concurrent funding in PE 0602131M). - Continued development of innovative relay Beyond Line of Sight (BLOS) technology through integration and demonstration of secure wireless networks/secure wireless local area network (LAN) communication technologies. (Concurrent funding in PEs 0602131M, 0602236N, 0603236N and 0603782N). - Completed development and transition of Asymmetric Threat Weapon technologies. (Transitioned from PE 0602131M and 0602123N) - Completed development and transition unambiguous warning devices technologies. (Transitioned from PE 0602131M) - Completed development and transition active RPG defense technologies. (Transitioned from PE 0602131M) - Completed development and transition improved imaging (Electro Optic/InfraRed/Laser) technologies. (Transitioned from PE 0602131M) - Completed development and transition reconfigurable surveillance Unmanned Aerial Vehicles (UAVs) for Warfighter protection technologies. (Transitioned from PE 0602131M) - Initiated development of transparent urban structures technologies. (Concurrent funding from PE 0602131M) - Initiated development of modular scalable effects prototype weapon. (Concurrent funding from PE 0602131M) - Initiated development of counter improvised explosive devices technologies. (Concurrent funding from PE 0602131M) - Initiated development of tactical urban breaching technologies. (Concurrent funding from PE 0602131M) *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2223	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate development of individual Warfighter protection technologies. (Concurrent funding in PE 0602131M; funding will also be provided by PE 0603236N in FY 2009). - Initiate development of advanced survivability and mobility technologies for Marine Corps tactical and combat vehicles. (Concurrent funding in PE 0602131M; funding will also be provided by PE 0603236N in FY 2009). *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete development and transition of improved fire control technologies based on small-scale hardened non-magnetic azimuth sensor to improve timeliness and accuracy of mortars/howitzers.					
LOGISTICS 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. FY 2009 reflects an increase for sustainability/logistics programs (includes fuel, water, ammunition, rations, and casualty care /MEDEVAC) in support of Distributed Operations; new USMC priorities in lightening the load of the individual Marine and enhancing the Marine Corps rifle squad's overall capabilities; and for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for: - Pre-detonation of IEDs; - Personal protection materials; - Personal power generation; - Micro power sources; and		3.200	7.881	11.526	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2223

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Augmented reality. The Logistics activity directly supports the integrated demonstration program, which will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes. The FY 2009 to FY 2010 funding increase results from plans to accelerate and complete development of both the portable fuel analyzer and the lightweight thermoelectric generator efforts. *FY 2008 Accomplishments:* - Continued exploring the development of portable fuel cell technologies capable of providing power in the 100 Watt to 500 Watt power range. - Continued efforts to develop a micro turbine generator capable of 100W average power. - Continued 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. (Realigned from PE 0602131M.) - Completed development of vehicle embarked & powered manipulator arm for next generation expeditionary vehicles. - Initiated analysis of material alternatives for automated vehicle health monitoring and reporting. - Initiated development of a tracking capability for major classes of supplies, forces & equipment. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Initiate technology demonstration for responsive precision aerial logistic transport from Seabase to Distributed Operations Squad or Platoon. - Initiate technology demonstration of an innovative bridge structure constructed from highly versatile modular composite components, thus expanding site-specific assembly options while simplifying logistic transport.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2223	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate development of a backpack that prevents oscillatory and transient peak loading forces from causing skeletal injury while enhancing human mobility with heavy loads. - Initiate development of a man-portable capability to analyze captured fuel for adulterants and contaminants. - Initiate development of a lightweight man-portable multi-fuel thermoelectric battery charger. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete development of portable fuel analyzer. - Complete development of lightweight thermoelectric generator. - Initiate the development and demonstration of advanced materials for corrosion prevention and wear reduction for USMC vehicles and equipment.					
MANEUVER The Maneuver Thrust Technology 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, modularity, and unmanned systems. Beginning in FY 2009, Mine Countermeasures (MCM) efforts are funded under the Force Protection activity. Presently, MCM supports and enhances the maneuver and force protection Marine landing forces with the development of technologies to enable detection, neutralization, breaching, and clearing of mines, Improvised Explosive Devices (IEDs), and unexploded ordnance from the beach exit to inland objectives. MAGTF MCM is a functional component of Naval Expeditionary Maneuver Warfare and includes Ship to Objective Maneuver (STOM), Expeditionary Operations from a Sea Base, sustained Operations Ashore, Urban and Asymmetric Operations, and OOTW. The $11,590K increase in FY2008 funds in PE0603640M is Supplemental funding for a project designated as NIRF (Neutralizing Improvised Explosive Devices with RF). This is a high priority Science and Technology (S&T) effort with the objective of minimizing the casualties being inflicted by improvised explosive devices (IEDs). The successful neutralization of threat IEDs will provide the warfighter with a		16.955	8.656	10.647	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2223	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

capability to remotely “safe” devices that are rapidly proliferating in areas where US troops are currently deployed.

FY 2009 reflects an increase for a DoD directed integrated capability demonstration supporting the Protection of Ground Forces and Systems. This capability demonstration has been directed to be wide ranging and encompass technologies for:
- Pre-detonation of IEDs;
- Personal protection materials;
- Personal power generation;
- Micro power sources; and
- Augmented reality.

The Maneuver activity directly supports this integrated demonstration which will be a broad, multi-year thrust to both investigate technology integration as well as spur application of more fundamental technologies to force and platform protection. The goal is multiple broad phased force protection applications and technologies, with off-ramps for fielding successes.

The FY 2009 to FY 2010 increase in funding is due to expanded Survivability/Active Protection Systems Improvement efforts to increase effectiveness of defeat (Pdefeat) of shoulder launched Rocket-Propelled Grenade (RPG) type threats and Anti-Tank Guided Missile (ATGM) threats on light platforms utilizing non-kinetic kill technologies.

FY 2008 Accomplishments:
- Continued Advanced Electromagnetic Armor technology development efforts.
- Continued development of technologies to defeat side/top attack and advanced fuze mines through signature reduction and advanced signature duplication.
- Continued S&T programs to address MAGTF Land MCM Master Plan capability gaps.
- Continued development of technologies to defeat advanced mine fuzes (seismic, acoustic, and infrared).

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2223

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued the formation of blast consortia to foster the increased understanding of blast and fragmentation interaction with vehicles and biological effects. - Continued development of a Combat S&T vehicle prototype to enhance crew survivability and vehicle fuel efficiency. - Continued efforts to detect IEDs using radio frequency sources. - Continued studies to identify technology development plans to close identified force protection capability gaps. - Continued development of a test bed to demonstrate advanced survivability concepts. - Completed development of scalable explosive neutralization technologies for MCM. - Completed Advanced ECASS development in support of HMMWV, MAGTF Expeditionary Family of Fighting Vehicles and other Light Armored Vehicles. - Completed and transitioned continued development of technologies to locate and defeat IEDs into PEs associated with the FNC program. - Completed Electromagnetic Non-Explosive Reactive Armor (E-NERA). - Initiated technology development programs to address force protection capability gaps. - Initiated development of fuel efficiency and battlefield power systems for improved performance. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Initiate development of a Combat S&T Vehicle demonstrator to enhance crew survivability and vehicle fuel efficiency. - Initiate survivability improvements and technologies to mitigate acceleration and traumatic brain injuries to occupants to enhance tactical mobility and survivability in support of Distributed Operations. - Initiate advanced suspension systems development with ride height adjustment, ride quality adjustment, rollover prevention, and load equalizing systems for USMC tactical wheeled platforms to enhance tactical mobility in support of Distributed Operations. - Initiate a Survivability/ Active Protection Systems Improvement effort to increase effectiveness of defeat (Pdefeat) of shoulder launched RPG type threats and ATGM threats on light platforms utilizing non-kinetic kill technologies.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2223

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiate new mobility efforts for On-Board Vehicle Power to increase mobile exportable power for Diesel Electric Propulsion Concepts and a Fuels effort to investigate future fuel alternatives for internal combustion engines to include Fischer-Tropsch and coal gasification processes for use in military tactical wheeled vehicles. - Initiate Maneuver Enabling Technologies such as Vehicle Stabilization to improve vehicle suspension and control technologies to stabilize the platforms themselves to improve ride quality, shoot on the move capability and human systems integration. - Initiate a Vehicle Demonstrator program to design and fabricate an Integrated Power Demonstrator platform capable of producing the power needs for mobility and survivability concept demonstrations. *FY 2010 Plans:* - Continue all efforts of FY 2009.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2223

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0204163N/Fleet Telecommunications (Tactical)									Continuing	Continuing
PE 0206313M/Marine Corps Communications Systems									Continuing	Continuing
PE 0206623M/Marine Corps Ground Combat/ Supporting Arms Systems									Continuing	Continuing
PE 0305204N/Tactical Unmanned Aerial Vehicles									Continuing	Continuing
PE 0601152N/In-House Laboratory Independent Research									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602131M/Marine Corps Landing Force Technology									Continuing	Continuing
PE 0602236N/Warfighter Sustainment Applied Research									Continuing	Continuing
PE 0602702E/Tactical Technology									Continuing	Continuing
PE 0602782N/Mine and Expeditionary Warfare Applied Research									Continuing	Continuing
									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2223

PE 0603004A/Weapons and Munitions Advanced Technology		
PE 0603005A/Combat Vehicle and Automotive Advanced Technology	Continuing	Continuing
PE 0603235N/Common Picture Advanced Technology	Continuing	Continuing
PE 0603236N/Warfighter Sustainment Advanced Technology	Continuing	Continuing
PE 0603606A/Landmine Warfare and Barrier Advanced Technology	Continuing	Continuing
PE 0603607A/Joint Service Small Arms Program	Continuing	Continuing
PE 0603612M/USMC Mine Countermeasures Systems - Adv Dev	Continuing	Continuing
PE 0603619A/Landmine Warfare and Barrier - Adv Dev	Continuing	Continuing
PE 0603635M/Marine Corps Ground Combat/ Support System	Continuing	Continuing
PE 0603772A/Advanced Tactical Computer Science and Sensor Technology	Continuing	Continuing
	Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2223

PE 0603782N/Mine and Expeditionary Warfare Advanced Technology		
PE 0604710A/Night Vision Systems - SDD	Continuing	Continuing
PE 0604808A/Landmine Warfare/Barrier - SDD	Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

The primary objective of this PE is the development of technologies to meet unique Marine Corps needs in conducting Expeditionary Maneuver Warfare. The program consists of a collection of projects categorized by critical warfighting function. Individual project metrics reflect the technical goals of each specific project. Typical metrics include the advancement of related Technology Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)					PROJECT NUMBER 2297	
COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
2297: CMC WARFIGHTING LAB CORE	37.172	36.271	36.620						Continuing	Continuing

A. Mission Description and Budget Item Justification

Marine Corps Warfighting Laboratory (MCWL) examines lessons learned from current operations, explores emerging threats and opportunities, and explores Joint and emerging service concepts through concept-based experimentation in order to enhance current and future warfighting 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.

"Live experimentation" permits exploration of prototype and surrogate technologies, as well as Tactics, Techniques, and Procedures (TTPs), 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. Experimentation encompasses inquiries into multiple warfighting areas, including: Command, Control, Communications, and Computers (C4); Intelligence, Surveillance, and Reconnaissance (ISR); Fires, Targeting, and Maneuver; Combat Service Support (CSS) and Force Protection; and Warfighting Excellence.

Using operational forces, MCWL conducts Advanced Warfighting Experiments (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 AWE-level campaigns are constructed. These campaigns (e.g., the Sea Viking (SV) experimentation series) are executed under the guidance of the Commandant of the Marine Corps (CMC) and in support of the Marine Air-Ground Task Force (MAGTF) Requirements List (MRL). The following provides an overview of MCWL experimentation:

- Sea Viking 2008 (SV08): (FY 2007 through FY 2008) SV08 continued exploration of Distributed Operations (DO). Experiments in this area take place in the context of the irregular, nonlinear, battlespace which demands enhanced individual and small unit capabilities. In addition to infantry, SV08 examined logistics, command and control (C2), fires, and ISR. With the conclusion of SV08, DO experimentation evolved into focus on Enhanced Company Operations (ECO).

- The ECO experiment series represents a major evolution in Marine infantry company operations. In the extended battlespace encountered in current and future operations, companies are required to execute functions normally conducted at battalion level and higher. ECO seeks to investigate structure, TTPs, training and

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2297

equipment that will enable companies to effectively conduct full spectrum combat operations across an extended battlespace. ECO also seeks to use computer based simulation systems to expand the training opportunities and mission rehearsal capabilities.

- MCWL experimentation in FY 2010 and beyond will continue to address the broad challenges of seabased expeditionary warfare focused on the tactical levels. Specific areas of interest are reflected in the projects listed below which deal with outcomes impacting today's Marine Corps, the next Marine Corps, and Marine Corps after next.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
COMBAT SERVICE SUPPORT (CSS) AND FORCE PROTECTION	9.857	4.096	2.937	
This activity includes MCWL CSS and force protection experimentation efforts including assessment of equipment, new TTPs, training programs, and proposed organizational changes associated with enhanced capabilities. Although this category covers several small (less than $500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact. FY 2008 funding level reflects a Supplemental increase of $3.6M to support Extended User Evaluation (EUE) of the Improvised Explosive Device (IED) Detector Dog program. The decrease from FY 2009 to FY 2010 is due to the completion of the IED Detector Dog EUE. *FY 2008 Accomplishments:* - Continued Mine Counter-Measures (MCM)/Counter-IED efforts for mine and IED clearance, detection, and neutralization. - Continued to develop and experiment with bio-science (medical) technologies. - Continued experimentation of simulation based training technologies to enhance small unit leader decision-making ability (transitions to Warfighting Excellence activity in FY 2010). - Continued development and experimentation with concept demonstrators that enable distribution of material from the seabase to small, widely dispersed units ashore. - Continued development and experimentation of logistics-related equipment and employment tactics tailored to the requirements of logistics units supporting DO/ECO.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2297	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Completed IED Detector Dog experiment that merged specialized breeding, urban conditioning, and multi-disciplinary training techniques in support of small unit infantry operations. Effort supports Operation Iraqi Freedom (OIF). - Completed experiment to develop training, organization, and equipment allowance modifications for logistics units based on the requirement to support DO/ECO. - Initiated IED Detector Dog Extended User Evaluation (EUE). Augments FY 2008 Supplemental funding. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Complete MCM/Counter-IED efforts for mine and IED clearance, detection, and neutralization. - Complete IED Detector Dog EUE. - Complete development and experimentation with logistics-related equipment tailored to requirements of DO/ECO. - Complete development and experimentation with concept demonstrators that enable distribution of material from the seabase to small, widely dispersed, units ashore. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Initiate assessment of technologies for sustainment of tactical level units from the sea-base. - Initiate assessment of unmanned ground logistics delivery technologies that support infantry small unit operations. - Initiate new investigations into point-of-wound stabilization and emerging technologies that support casualty evacuation (CASEVAC)/casualty extractions using robots.					
COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS (C4) This activity encompasses all MCWL C4 related experimentation efforts including assessment of equipment, new TTPs, training programs, and proposed organizational changes associated with enhanced C4 capabilities. Although this category covers several small (less than $500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact.		8.082	8.437	8.700	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2297	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2008 Accomplishments: - Continued C4 extended user assessments of selected prototype technologies in support of forces engaged in Operation Enduring Freedom and Operation Iraqi Freedom (OIF). - Continued experimentation of concept demonstrators to support company and below alternative C2 architectures. - Continued C4 related small unit enhancements against irregular forces, including urban terrain. - Completed experimentation of enhanced over-the-horizon (OTH) communications Low Earth Orbit Satellite (LEOSAT)/Line of Sight (LOS) hybrid in support of SV08. - Completed experimentation of coalition C4 interoperability concept demonstrator. - Completed C4 support for SV08. - Completed experimentation of enhanced communications concept demonstrators as part of SV08. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Initiate and complete C4 support for ECO experiments. - Initiate and complete experimentation of enhanced communications concept demonstrators as part of ECO. - Initiate development and assessment of a voice-to-voice automated language translator concept demonstrator. *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete C4 related small unit enhancements against irregular forces, including urban terrain. - Initiate assessment of network management systems for Capability Set (CAPSET) V (all C2 below Battalion) networks. - Initiate assessment of an integrated company level C4 ISR network.					
FIRES, TARGETING, AND MANEUVER		2.857	3.243	3.107	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2297	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
This activity includes MCWL experimentation efforts in the areas of fires, targeting, and maneuver including assessment of equipment, new TTPs, training programs, and proposed organizational changes associated with enhanced capabilities. Although this category covers several small (less than $500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact. FY 2009 funding was realigned to pursue automated aviation and surface fires de-confliction, as well as small unit precision munitions, loitering weapons, and armed UAS concept demonstrator assessments. *FY 2008 Accomplishments:* - Continued evaluation of alternative counter shooter technologies. - Continued development and assessment of Heavy Machine Gun Initiative (HMGI), an effort to design advanced mounts for USMC crew served weapons. *FY 2009 Plans:* - Continue all efforts in FY 2008. - Complete development and assessment of HMGI. - Initiate assessment of an automated aviation and surface fires de-confliction system concept demonstrator. - Initiate assessment of small unit precision munitions/loitering weapons/armed UAS concept demonstrators. *FY 2010 Plans:* - Continue all efforts in FY 2009, less those noted as completed above. - Initiate assessment of concept demonstrator precision targeting device.					
INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR) This activity includes MCWL ISR related experimentation efforts including assessment of equipment, new TTPs, training programs, and proposed organizational changes associated with enhanced ISR capabilities.		4.212	7.148	7.108	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2297

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Although this category covers several small (less than $500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact. FY 2008 funding was realigned from Tier II Unmanned Aerial System (UAS) payloads concept demonstrator efforts to the Combat Service Support (CSS) and Force Protection area in support of the initiation of Improvised Explosive Device (IED) Detector Dog Extended User Evaluation (EUE). *FY 2008 Accomplishments:* - Continued additional IED investigations into promising detect and neutralize technologies. - Continued experimentation with TTPs and payloads for a Tier II Unmanned Aerial System (UAS) concept demonstrator to provide persistent ISR at regimental and battalion level. - Continued efforts to develop the TTPs required for small infantry units to employ Unmanned Ground Vehicles (UGVs), UASs, and unattended ground sensors. - Continued experimentation with the Small Unit Surveillance System (SUSS) and the Mobile Wearable Computer (MOWC). - Completed development and experimentation of ISR technologies in preparation for SV08 planned experiments. - Completed experimentation of enhanced ISR technologies and concept demonstrators as part of SV08. - Completed participation in Defense Advanced Research Projects Agency's (DARPA's) development and upgrade of the Wasp micro UAS and conducted extended operational assessment of Wasp Block II and Block III, in support of DO experimentation and OIF. - Completed ISR related small unit enhancements against irregular forces, including urban terrain. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Complete experimentation with SUSS and MOWC. - Initiate development and experimentation with a networked suite of small unit disposable sensors to enhance small unit force protection.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)			PROJECT NUMBER 2297	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2010 Plans: - Continue all efforts of FY 2009, less those noted as completed above. - Initiate assessment of an integrated company level C4 ISR network. - Initiate investigations into rotary wing/hovering tactical level UAS concept demonstrators.					
MARINE CORPS WARFIGHTING LABORATORY (MCWL) OPERATIONS (SUPPORT) MCWL Operations (Support) efforts include overall MCWL experimentation doctrine, planning, analysis, data collection, as well as technology transition tracking efforts. Although this category covers several small (less than $500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at $500K or more) or have near real-time operational impact. FY 2008 funding was realigned due to a reduced level of anticipated overall analysis and management/ strategic planning support and an execution adjustment at the program level. *FY 2008 Accomplishments:* - Continued to synthesize results and lessons learned into proposed DOTMLPF recommendations for the Marine Corps. - Continued to provide technical, strategic, and managerial support to Marine Corps experimentation. - Continued to provide overall analysis and reporting of experimentation efforts, analytical assistance during experiment design, and maintenance of an ad-hoc analysis capability. - Completed engineering, technical and data collection support for SV08. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. *FY 2010 Plans:* - Continue all efforts of FY 2009.		7.488	7.902	8.629	
WARFIGHTING EXCELLENCE		4.676	5.445	6.139	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2297

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
This activity includes MCWL efforts in the development and assessment of joint and service warfighting concepts, joint and service missions, analysis of emerging threats and opportunities, and joint capability experimentation. It also includes MCWL service experimentation in areas that impact multiple warfighting functions. Although this category covers several small (less than $500K per FY) efforts being pursued by MCWL, most programs listed below are considered major (valued at $500K or more) or have near-real-time operational impact. FY 2008 to FY 2009 funding increase is due to an increased level of support to complete technology assessment and operational evaluation of DARPA-developed robotic prototypes. FY 2010 and beyond funding was realigned from CSS and Force Protection area in support of experimentation of simulation based training technologies. *FY 2008 Accomplishments:* - Continued executive agent responsibilities for Joint Title X programs, such as Unified Quest, Unified Course, and Unified Engagement. Title X war games address future capabilities in the context of Title X readiness responsibilities. - Continued management and oversight of non-Title X Wargaming, including the highly visible Office of the Secretary of Defense Net Assessment Transformation War Game series and the Special Operations Command wargaming series. - Continued to conduct quarterly Emerald Express seminars that resulted in collection and dissemination of insights and observations from the Operating Forces. Produced reports for the purpose of professional military education and advancing the lessons-learned process. - Continued to support the Center for Emerging Threats and Opportunities (CETO) mission: 1) prevent operational and tactical surprises to senior Warfighting Commanders by assessing future security environments in light of emerging threats and potential conceptual and technological opportunities; 2) help focus science, technology, and experimental efforts by appraising promising concepts and technologies; 3) serve as a catalyst to stimulate thought and debate on issues of importance to the Marine Corps.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2297

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continued funding contributions to Joint Concept Technology Demonstrations (JCTDs) and Advanced Concept Technology Demonstrations (ACTDs). Both JCTDs and ACTDs are intended to rapidly field needed capabilities by using emergent mature technologies matched with innovative operational concepts. - Continued technology assessment and operational evaluation of DARPA-developed robotic prototypes in support of DO/ECO experimentation. - Completed concept development and Modeling and Simulation support for SV08. *FY 2009 Plans:* - Continue all efforts of FY 2008, less those noted as completed above. - Complete technology assessment and operational evaluation of DARPA-developed robotic prototypes in support of DO/ECO experimentation. *FY 2010 Plans:* - Continue all efforts of FY 2009, less those noted as completed above. - Continue experimentation of simulation based training technologies to enhance small unit leader decision-making ability (transitions from CSS activity).				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0602131M/Marine Corps Landing Force Technology									Continuing	Continuing

D. Acquisition Strategy

Not Applicable.

E. Performance Metrics

The primary objective of this PE is the development of technologies to meet unique Marine Corps needs in conducting Expeditionary Maneuver Warfare. The program consists of a collection of projects categorized by critical warfighting function. Individual project metrics reflect the technical goals of each specific project. Typical

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603640M USMC ADVANCED TECHNOLOGY DEMONSTRATION (ATD)	PROJECT NUMBER 2297

metrics include the advancement of related Technology Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603651M JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	10.667	12.984	10.998						Continuing	Continuing
3022: JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT	10.667	10.989	10.998						Continuing	Continuing
9999: CONGRESSIONAL PLUS-UPS	0.000	1.995	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

The DOD's Joint Non-Lethal Weapons Program (JNLWP) was established by the Secretary of Defense, who assigned centralized responsibility for DOD joint research and development of non-lethal technology to the Commandant of the Marine Corps as the Executive Agent. The Under Secretary of Defense for Acquisition, Technology and Logistics provides direct oversight of the JNLWP.

The efforts described in this Program Element (PE) reflect science and technology (S&T) investment decisions provided by the Joint NLW Integrated Product Team, a multi-service flag level corporate board that executes the JNLWP for the Commandant of the Marine Corps. This direction is based on the needs and capabilities of the Services, the Special Operations Command, and the Coast Guard, as identified in the DoD's Non-Lethal Weapons Joint Capabilities Based Assessment Document. This coordinated joint S&T development approach addresses mutual capability gaps and assures the best non-lethal technologies and equipment are provided to the operating forces while eliminating duplicative service S&T investment.

This program funds the 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 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, vessels, and also in close proximity to high-value civilian facilities. By order of the Under Secretary of Defense for Acquisition, Technology, and Logistics, the Marine Corps is established as the Executive Agent for DoD Joint Non-Lethal Weapons RDT&E.

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

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603651M JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	10.736	11.020	11.167	
Current BES/President's Budget	10.667	12.984	10.998	
Total Adjustments	-0.069	1.964	-0.169	
Congressional Program Reductions		-0.035		
Congressional Rescissions				
Total Congressional Increases		2.000		
Total Reprogrammings				
SBIR/STTR Transfer	-0.069			
Program Adjustments			-0.170	
Rate/Misc Adjustments		-0.001	0.001	

Congressional Increase Details ($ in Millions)

	FY 2008	FY 2009
Project: 9999, **EYE SAFE LASER WARNING SYSTEMS**	0.000	1.995

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603651M JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT					PROJECT NUMBER 3022	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
3022: JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT	10.667	10.989	10.998						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds the research and development of next-generation NLWs and includes performing analysis, technical development efforts, and modeling and simulation necessary to ensure optimum weaponization and use of these NLWs. Investment areas include research and development of next-generation NLWs such as: non-lethal directed energy weapons (lasers, millimeter wave and high power microwave) for counter-personnel and counter-material missions; non-lethal counter-personnel technologies (acoustic, optical, and human electro-muscular disruption technologies), and advanced non-lethal materials (including materials for vehicle/vessel stopping and counter-facility applications). Next-generation NLW systems focus on long-range localized NL effects to identified threat individuals (or groups of individuals) and/or their threat weapons systems operating in complicated environments such as urban areas, crowds, buildings, vehicles, vessels, and also in close proximity to high-value civilian facilities.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
JOINT NON-LETHAL WEAPONS	10.667	10.989	10.998	
FY 2008 Accomplishments: - Continued effort to 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. - Continued design of a man-transportable laser weapons system that can be used for non-lethal counter-personnel or non-lethal counter-materiel applications through ultra-high precision engagement of selected targets with minimal collateral damage. - Continued research to define the optimum approaches, technologies and tactics necessary to clear a facility/building with and without entry. - Continued characterization of bioeffects induced via acoustic non-lethal weapon concepts. - Continued modeling/research to develop an understanding of the complex relationships between individual, group and crowd dynamics in order to predict the macro effects of NLWs. Specifically,				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603651M JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT			PROJECT NUMBER 3022	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
investigate factors that cause crowds to move to violent behavior, and what non-lethal technologies will be effective in controlling or mitigating violent crowd behavior. - Continued effort to examine and optimize non-lethal effects and effectiveness of various non-lethal stimuli, to include light, acoustics, electrical, high power laser, high power microwave and active denial technology. Research includes human effects analysis with respect to existing non-lethal stimuli and other emerging system stimuli to characterize behaviors and their operational relevance. - Initiated prototype development and demonstration of the most promising candidate technologies addressing the vehicle/vessel stopping capability gap. - Initiated non-lethal effects characterization through modeling and effects testing using the Advanced Total Body Model. - Initiated prototype development and demonstration of the most promising directed energy technologies under consideration for counter-personnel and counter-materiel applications. - Initiated prototype development and demonstration of the most promising candidate technologies employing multi-sensory stimuli. - Initiated investigations of technology advancements to miniaturize proven non-lethal weapon prototypes /demonstrators to enable their transition to tactically relevant, cost effective capabilities in the field. *FY 2009 Plans:* - Continue all efforts from FY 2008. - Complete demonstration and transition of the most effective vehicle/vessel stopping technologies to acquisition programs. - Complete demonstration and transition of the most effective directed energy technologies with counter-personnel and counter-materiel applications to higher categories of development/acquisition. - Initiate prototype development of advanced payloads for candidate technological capabilities with applications relevant to emerging capability gaps. - Initiate prototype development and demonstration of the most promising candidate technologies addressing the extended range/duration incapacitation capability gap.					

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603651M JOINT NON-LETHAL WEAPONS TECHNOLOGY DEVELOPMENT	PROJECT NUMBER 3022

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2010 Plans: - Continue all efforts from FY 2009, less those noted as completed above. - Complete characterization of bioeffects induced via acoustic non-lethal weapon concepts. - Initiate transition to higher levels of development and demonstration for the most promising candidate technologies employing multi-sensory stimuli.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0602651M/Joint Non-Lethal Weapons Applied Research									Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

The primary objective of this Program Element is the development of technologies that lead to the next-generation of Non-Lethal Weapons which address identified and prioritized joint NLW capability gaps. The program consists of a collection of projects for the development and evaluation of feasibility demonstration models. Individual project metrics reflect the technical goals of each specific project. Typical metrics include both the effectiveness of the technology, human effects and effectiveness, mitigation of high priority joint NLW capability gaps, and potential for compliance with policy and legislation. Overarching considerations include the advancement of related Technology Readiness Levels and Human Effects Readiness Levels, the degree to which project investments are leveraged with other performers, reduction in life cycle cost upon application of the technology, and the identification of opportunities to transition technology to higher categories of development.

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603729N WARFIGHTER PROTECTION ADVANCED TECHNOLOGY					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	50.670	53.766	18.609						Continuing	Continuing
2914: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY	14.178	12.079	18.609						Continuing	Continuing
9999: CONGRESSIONAL PLUS-UPS	36.492	41.687	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

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. The National Institutes of Health (NIH) focuses on the basic science of disease processes and not product development. Programs are coordinated with other Services through the Armed Services Biomedical Research Evaluation Management (ASBREM) Committee to prevent duplication of effort. This project funds the Force Health Protection program a Future Naval Capability (FNC) that will provide technology options for future Navy and Marine Corps capabilities and supports the "Sea Warrior" component of the Naval Transformation Roadmap, medical logistics aspects of "Sea Basing" and expeditionary force medical support associated with "Sea Strike".

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

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603729N WARFIGHTER PROTECTION ADVANCED TECHNOLOGY

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	49.418	12.129	12.641	
Current BES/President's Budget	50.670	53.766	18.609	
Total Adjustments	1.252	41.637	5.968	
Congressional Program Reductions		-0.146		
Congressional Rescissions				
Total Congressional Increases		41.800		
Total Reprogrammings	2.272			
SBIR/STTR Transfer	-1.020			
Program Adjustments			5.962	
Rate/Misc Adjustments		-0.017	0.006	

Congressional Increase Details ($ in Millions)	FY 2008	FY 2009
Project: 9999, **AMELIORATION OF HEARING LOSS**	0.000	0.997
Project: 9999, **C. W. BILL YOUNG BONE MARROW DONOR RECRUITMENT AND RESEARCH PROGRAM**	30.514	31.415
Project: 9999, **HIGH SPEED BLOOD AND FLUID TRANSFUSION EQUIPMENT**	0.000	3.092
Project: 9999, **INTEGRATED WARFIGHTER BIODEFENSE PROGRAM**	2.314	2.992
Project: 9999, **NEURAL CONTROL OF EXTERNAL DEVICES (ARTIFICIAL LIMB MOVEMENT)**	0.772	0.000
Project: 9999, **REPAIR OF MASSIVE TISSUE LOSS AND AMPUTATION THROUGH COMPOSITE TISSUE ALLOTRANSPLANTATION**	2.892	3.191

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603729N WARFIGHTER PROTECTION ADVANCED TECHNOLOGY					PROJECT NUMBER 2914	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
2914: WARFIGHTER PROTECTION ADVANCED TECHNOLOGY	14.178	12.079	18.609						Continuing	Continuing

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. The NIH focuses on the basic science of disease processes and not product development. Programs are coordinated with other Services through the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee to prevent duplication of effort. This project funds the Force Health Protection program a Future Naval Capability (FNC)that will provide technology options for future Navy and Marine Corps capabilities 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 ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
BONE MARROW RESEARCH	0.000	0.000	0.986	
The goal of the Bone Marrow program is to test, develop and evaluate military contingency capabilities in order to improve care for casualties of marrow-toxic substances. This program will research efforts to refine and correctly identify matched marrow and matched platelets for casualties as well as military members with medical injuries including combat trauma. FY 2010 initiate and complete the Bone Marrow Research.				
FY 2010 Plans: - Initiate and complete the Bone Marrow Research.				
CASUALTY CARE AND MANAGEMENT	6.652	7.127	5.323	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603729N WARFIGHTER PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2914

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

The goal of Casualty Care and Management is to maximize the continuum of care with lifesaving interventions as close to the battlespace as possible. This is in an increasingly lethal battlespace, with reduced infrastructure and logistics.

The increase from FY 2008 to FY 2009 is due to the transition of some efforts from the Healthy and Fit Force activity (this PE) into the Casualty Care and Management activity. The decrease in funding from FY 2009 to FY 2010 is due to the completion of the Medical Planning Tools and Traumatic Brain Injury FNC efforts in this area, and the realignment of the Post Traumatic Stress Disorder Treatment FNC efforts into the Casualty Prevention activity of this PE.

FY 2008 Accomplishments:

- 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.
- Continued preclinical study to evaluate use of vasopressin to manage traumatic brain injury (TBI).
- Continued clinical trial evaluating safety of vasopressin for treatment of trauma patients.
- Continued efforts to develop a novel fibrinogen-like bandage using nanotechnology for hemorrhage control (internal and external).
- Continued efforts to develop prototype technology for closed-loop resuscitation for USMC En Route Care system.
- Continued remaining project to enhance medical planning tools for combat developers.
- Completed 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.
- Completed study to determine safety of hypotensive resuscitation in casualties in presence of hemorrhagic shock and hypothermia.
- Completed identification of Food and Drug Administration (FDA) approved products as well as new development of novel therapeutics that protect against the induction of hemorrhagic shock. A reduced need for resuscitation fluids would significantly reduce the medical logistical burden for Naval forces.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603729N WARFIGHTER PROTECTION ADVANCED TECHNOLOGY			PROJECT NUMBER 2914	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated study to demonstrate selectivity/specificity of biomarkers for mild & moderate TBI in appropriate pre-clinical model. - Initiated efforts to develop advanced technologies for First Responders. - Initiated efforts to develop advanced technologies to support the Forward Resuscitative Surgical System/ Expeditionary Resuscitative Surgical Systems (FRSS/ERSS). - Initiated program to develop advanced technologies to support En Route Care of casualties. *FY 2009 Plans:* - Continue all efforts of FY 2008 less those noted as completed above. - Continue program to examine comorbidity of traumatic brain injury. (Continuation of similar effort funded in Healthy and Fit Force activity of this PE prior to FY 2009.) - Complete preclinical study to evaluate use of vasopressin to manage TBI. - Complete 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. - Complete efforts to develop prototype technology for closed-loop resuscitation for USMC En Route Care system. - Complete Breacher study efforts at the Dynamic Entry School/Quantico a component of the FRSS/ ERSS. - Initiate efforts to treat the psychological manifestations' of combat stress. - Initiate Non-Surgical Control of Internal Bleeding program. - Initiate pharmacologic research studies to support an FDA Investigational New Drug (IND) application. - Initiate Automated Casualty Care System Development program. *FY 2010 Plans:* - Continue all efforts of FY 2009 less those noted as completed above. - Initiate research to enhance force readiness by mitigating the impact of environmental stressors. - Initiate development of emerging technologies that support delivery of approved FNC enabling capabilities structured to close operational capability gaps in warfighter sustainment.					
CASUALTY PREVENTION		6.185	4.952	6.527	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603729N WARFIGHTER PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2914

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Casualty Prevention includes protecting the warfighter from environmental, occupational and battlefield threats. The increase in funding from FY 2009 to FY 2010 is due to the initiation of emerging technologies that support delivery of approved FNC enabling capabilities and to increased investments for Post Traumatic Stress Disorder Treatment FNC efforts in this activity. *FY 2008 Accomplishments:* - Completed development of improved hearing protection systems, educational tools, and pharmacological treatment paradigms to protect and restore hearing in Warfighters exposed to high-noise environments. - Completed 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). - Initiated efforts to mitigate the effects of environmental and other threats to health. - Initiated efforts to reduce operational injuries. *FY 2009 Plans:* - Continue all efforts of FY 2008 less those noted as completed above. - Continue research to determine the safety and efficacy of perfluorocarbons in treating decompression sickness and arterial gas embolism. (Realigned from Healthy and Fit Force activity of this PE after 2008.) - Initiate development of tools to prevent psychological stress and PTSD. (Continuation of similar effort funded in Healthy and Fit Force activity of this PE prior to FY 2009.) *FY 2010 Plans:* - Continue all efforts of FY 2009. - Complete research to determine the safety and efficacy of perfluorocarbons in treating decompression sickness and arterial gas embolism. - Initiate research to enhance force readiness by mitigating the impact of environmental stressors.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603729N WARFIGHTER PROTECTION ADVANCED TECHNOLOGY			PROJECT NUMBER 2914	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiate development of Human Injury and Treatment (HIT) model to assess personnel survivability, optimal personnel treatment, and restoration of ship operational capabilities.					
HEALTHY AND FIT FORCE 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. This effort moves to Casualty Care and Management and Casualty Prevention activities in this PE in FY 2009. *FY 2008 Accomplishments:* - Completed evaluations of pharmacological compounds to combat motion-sickness in aviators without causing fatigue or cognitive deficit. - Completed program for creating strategies to “inoculate” Warfighters against the effects of combat related stressors. - Completed Virtual Reality Therapy Tools for acute PTSD. - Completed development of decision support tools for controlling disease and non-battle injuries on Navy vessels. - Initiated program to examine comorbidity of traumatic brain injury. (This effort moves to Casualty Care and Management activity in this PE in FY 2009.) - Initiated research to determine the safety and efficacy of perfluorocarbons in treating decompression sickness and arterial gas embolism. (This effort moves to Casualty Prevention activity in this PE in FY 2009)		1.341	0.000	0.000	
NAVAL NOISE-INDUCED HEARING LOSS (NIHL) The goal of this program is to reduce the incidence of NIHL by nearly 100%. This program employs a total systems engineering approach that includes advancements in medical technology, jet engine physics, personal protective equipments, and mitigation analyses. Similar/related research was previously funded within this PE.		0.000	0.000	5.773	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603729N WARFIGHTER PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2914

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
The increase of funds in FY 2010 are in support of applied research efforts. *FY 2010 Plans:* - Initiate advanced research in medical prevention and treatment of NIHL and tinnitus (ringing in the ears). - Initiate advanced research to reduce noise at the source, i.e. jet engine quieting and flight deck noise reduction. - Initiate advanced research to improve personal protective equipment technology. - Initiate advanced research to study the incidence and susceptibility of NIHL and tinnitus, and to evaluate mitigation strategies.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603729N WARFIGHTER PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2914

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602202F/Human Effectiveness Applied Research									Continuing	Continuing
PE 0602235N/Common Picture Applied Research									Continuing	Continuing
PE 0602236N/Warfighter Sustainment Applied Research									Continuing	Continuing
PE 0602716A/Human Factors Engineering Technology									Continuing	Continuing
PE 0602785A/Manpower/ Personnel/Training Technology									Continuing	Continuing
PE 0602787A/Medical Technology									Continuing	Continuing
PE 0603002A/Medical Advanced Technology									Continuing	Continuing
PE 0603231F/Crew Systems and Personnel Protection Technology									Continuing	Continuing
PE 0603236N/Warfighter Sustainment Advanced Technology									Continuing	Continuing
PE 0604771N/Medical Development									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603729N WARFIGHTER PROTECTION ADVANCED TECHNOLOGY	PROJECT NUMBER 2914

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Efforts within this PE are measured at two levels. At the lower level, each is measured against technical and financial milestones on a monthly basis. Annually, each project is reviewed in depth for technical and transition performance by the Chief of Naval Research (CNR).

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	73.123	83.565	68.037						Continuing	Continuing
2916: UNDERSEA WARFARE ADVANCED TECHNOLOGY	70.024	81.171	68.037						Continuing	Continuing
9999: CONGRESSIONAL PLUS-UPS	3.099	2.394	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

All Navy advanced technology development in undersea target detection, classification, localization, tracking and neutralization is funded through this 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.

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	75.422	81.490	74.747	
Current BES/President's Budget	73.123	83.565	68.037	
Total Adjustments	-2.299	2.075	-6.710	
Congressional Program Reductions		-0.258		
Congressional Rescissions				
Total Congressional Increases		2.400		
Total Reprogrammings	-1.758			
SBIR/STTR Transfer	-0.541			
Program Adjustments			-6.660	
Rate/Misc Adjustments		-0.067	-0.050	

Congressional Increase Details ($ in Millions)

	FY 2008	FY 2009
Project: 9999, **DEEP WATER ACOUSTIC DETECTION SYSTEM**	3.099	0.000
Project: 9999, **THEATER UNDERSEA WARFARE INITIATIVE**	0.000	2.394

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY					PROJECT NUMBER 2916	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
2916: UNDERSEA WARFARE ADVANCED TECHNOLOGY	70.024	81.171	68.037						Continuing	Continuing

A. Mission Description and Budget Item Justification

All Navy advanced technology developments in undersea target detection, classification, localization, tracking and neutralization are 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 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 ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
ANTI-SUBMARINE WARFARE (ASW) DISTRIBUTED SEARCH	0.000	0.000	3.345	
ASW Distributed Search focuses the development of technologies for the non-covert tactical search for undersea targets ranging from hours to weeks using automated sensor systems deployed around operating areas including along key transit routes to protect naval/maritime forces, around temporarily fixed sea base regions and naval force operating areas, or around fixed defensive regions and areas of interest such as key US/Allied ports. "Non-covert" implies availability of airborne assets for sensor deployment (although other means may also be used), and the ability to employ active sonar along with passive and non-acoustic methods. "Search" is conducted in concentrated areas, typically exploiting cues received from surveillance systems. The submarine target must be detected beyond its weapons release range. The objective is to develop rapidly deployable systems employing automated detection and classification capabilities for use in both shallow and deep water operating environments. Distributed Search supports the ASW protected passage Maritime Shield operational constructs. Related efforts include the development of distributed systems employing optimization as well as active acoustic sensing and processing techniques, navy-unique transduction and underwater networking technology. Efforts also include the development of Unmanned Undersea Vehicle-based and affordable off-board deployable sensing systems employing persistent detection concepts and components. These efforts provide an				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
extended reach of organic platform-based systems through the use of new sensor concepts, improved materials for advanced sensors, optimized deployment, employment, and automated operation of distributed sensor fields. The cornerstone of Distributed Search is the development of rapidly deployable, long-endurance active sensors with automated processing suitable for use in a wide variety of operational environments. The FY 2009 to FY 2010 funding increase is due to the realignment of the Wide Area ASW Surveillance activity into this new activity. *FY 2010 Plans:* The following efforts were transferred to this new activity from the FY 2009 Wide Area ASW Surveillance activity: - Continue development of Distributed Systems Processing (DSP) threat submarine feature association and field tracking algorithms for active and passive distributed acoustic ASW systems. - Initiate development high fidelity computer-based simulation training with linked architecture that supports ASW training from the operator-level to the ASW Commander-level applicable to both surface and air platforms.				
ANTI-SUBMARINE WARFARE (ASW) PERFORMANCE ASSESSMENT The goal of this work is to integrate ocean and atmospheric environmental characteristics with sensor performance predictions in order to develop algorithms and Tactical Decision Aids (TDAs) that will accurately predict overall sensor performance in a given environment in near real-time for both present and future situations. The results of these research efforts in conjunction with embedded state-of-the-art command and operator-level training will facilitate the optimum employment of ASW sensor systems, thus increasing their effectiveness and potentially decreasing the number of sensors used to provide coverage in a given area. This work will provide operational commanders with sensor performance predictions which allow them to accurately judge the performance of those sensors, as well as information with which to deploy them for the greatest operational effect. It will also provide information as to how the performance evolves over time due to effects such as the deformation of sensor locations by currents, sound velocity	0.000	0.000	6.417	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

profile changes, geologic magnetic interference changes, or changes to the optical properties of the water, etc. The effort includes performance predictions for fields of sensors as well as individual sensors themselves and applies to both acoustic and non-acoustic sensors.

Work includes development of ASW sensor and system performance models, and realistic simulations and measures of effectiveness that incorporate and exploit critical environmental knowledge. It includes efforts to couple ocean dynamics and acoustics, characterize ambient noise in the littorals, measure and model acoustic and optical propagation and scattering in complex environments, develop algorithms to extract environmental information from through-the-sensor measurements and quantification and prediction of uncertainty. This information is combined with the operating characteristics of particular sensors (or groups of sensors) to provide predictions of sensor performance in the environment at that particular time and in the future. The predictions will also include assessments of the prediction uncertainty due to environmental measurement and sensor performance uncertainties.

This work aligns principally with the Assure Access and Hold at Risk S&T Focus Area in the Naval S&T Strategic Plan and contributes measurably to the Operational Environments S&T Focus Area strategic objectives.

The FY 2009 to FY 2010 funding increase is due to the realignment of the Wide Area ASW Surveillance activity into this new activity.

FY 2010 Plans:
The following efforts were transferred to this new activity from the FY 2009 Wide Area ASW Surveillance activity:

- Continue a research effort focusing on distributed system in-situational environmental characterization and system monitoring.
- Continue a research effort to determine the placement of and follow-on control and pattern keeping of acoustic sources and mobile distributed sensor systems.
- Continue research effort aimed at the ideal placement of acoustic sources and drifting sensor systems.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete algorithm testing of uncontrolled drifting systems using a simulator. This effort transitioned from PE 0602747N in FY 2009. - Complete test planning of source algorithms to be used to determine the optimal initial placement of uncontrolled drifting distributed systems. - Complete development of algorithms to optimize the initial placement of uncontrolled drifting systems. This effort transitioned from PE 0602747N. - Complete development of a simulator for placement of uncontrolled drifting systems. This effort transitioned from PE 0602747N in FY 2009. This effort is intended to transition to Program Executive Office Air ASW, Assault and Special Mission Programs (PMA-264). The agreement is being negotiated and the details will be entered after the TA is signed.				
ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE ASW Surveillance focuses on dramatically improving detection, classification, and localization capabilities in large ocean areas relative to the capabilities of legacy ASW surveillance systems. The related technologies support the conduct of covert wide-area surveillance ranging from one day to six months. The objectives are to develop and demonstrate technologies that provide clandestine indications and warnings in far forward and contested operating areas and in complex operational environments against all submarine threats including new threats with unknown target signatures and tactics. Covertness implies use of non-observable platforms and/or deployed automated sensors employing passive sonar or other non-detectable methods. The surveillance process includes initial detection and classification. Efforts include the development of Unmanned Undersea Vehicle-based and affordable off-board deployable sensing systems employing a wide variety of surveillance concepts and components. These efforts focus on alternative detection phenomena, vector/tensor sensors, automated acoustic processing, more compact and longer lasting power sources, and high bandwidth acoustic communications links. The FY 2009 to FY 2010 funding increase is due to the realignment of the Wide Area ASW Surveillance activity into this new activity.	0.000	0.000	44.783	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2010 Plans: The following efforts were transferred to this new activity from the FY 2009 Wide Area ASW Surveillance activity: - Continue the On-Demand Detection Classification and Localization (ODDCL) effort focusing on the development of sensor and platform designs and key components compatible with a notional Concept of Operations. - Continue system level design and integration for ODDCL. - Continue development of a tactical area prototype system for PLUS. - Continue a PLUS prototype system simulation test in preparation for FY 2011 at-sea experiments. - Continue analysis of data collected during the FY 2010 PLUS at-sea experiments. - Continue two at-sea experiments focused on increasing system persistence capabilities. - Complete Submarine Track & Trail (STT) Baseline advanced research efforts in the areas of advanced undersea sensors, communications, autonomy, and sensor data collection and analysis to support tracking algorithm and automated processing development. - Complete DADS deployability, survivability and classification performance improvement effort. - Complete testing of the Palantir (a non-acoustic surveillance system) sensor system. - Complete tactical test planning for the Palantir sensor. - Complete DADS at-sea classification performance improvement testing. - Complete at-sea testing of integrated STT submersibles and evaluate overall system performance. - Complete DADS deployability, covert communications and survivability testing. - Complete at-sea demonstrations of STT submersible with fully integrated sensor package. - Initiate system level integration and testing for ODDCL. - Initiate development of a vector sensor towed array and associated signal processing with performance nominally equivalent to a "thin-line" (TB-29) twin-line towed array to be compatible with the existing TB-29 array handling system.				
BATTLEGROUP ANTI-SUBMARINE WARFARE (ASW) DEFENSE	2.506	0.000	0.000	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
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. The decrease in funding from FY 2008 to FY 2009 is due to the completion of the Multi-Mode Magnetic Detection System (MMMDS) project in FY 2008. Additionally, the decrease in Battlegroup ASW Defense supports a basic shift in Naval strategy away from platform-based undersea surveillance systems toward deployable, distributed systems. *FY 2008 Accomplishments:* - Completed the integration of MMMDS sensor hardware/software into towed vehicles flown by vertical takeoff unmanned aerial vehicle surrogates. - Completed MMMDS final reporting; transition to NAVAIR. - Initiated/completed MMMDS planning and execution of final over water demonstration with realistic target.				
NEUTRALIZATION Neutralization focuses on undersea weapons technologies to counter threat submarines by increasing the Probability of Kill (PK). The ultimate goals of Neutralization efforts are to develop reduced size advanced undersea weapons with revolutionary capabilities and to fill Sea Shield mission capability gaps and demonstrate transformational capabilities for ASW weapons. The increase in funding from FY 2008 to FY 2009 is due to the phased movement of Lightweight Torpedo Technologies (LTT) from Applied (6.2) to Advanced (6.3), which provides a tactically revolutionary PK against quiet diesel-electric submarines operating in harsh shallow water environments, and CRAW which is capable of deployment from an air-vehicle at low altitude to neutralize undersea threat targets from the	16.940	20.668	0.000	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
stand-off ranges of US Naval vessels. These research efforts began in FY 2007 and continue for five years and are targeted for transition in FY 2010 and FY 2011 respectively. These projects are funded in accordance with the FNC process and are approved by the Technology Oversight Group. The FY 2009 to FY 2010 funding decrease is due to the realignment of the Neutralization activity to the newly established Undersea Weaponry activity. *FY 2008 Accomplishments:* - Continued LTT integration of broadband and adjunct sensors for in-water data collection to result in a new dual-mode sensor guidance and control system for at-sea testing. - Continued feasibility investigations under LTT to quantify adjunct sensor configurations and signal processing approaches to enable positive discrimination of artificial targets at standoff ranges. This feasibility investigation is expected to result in five (5) new patent applications. (Transitioned from PE 0602747N) - Continued LTT feasibility investigations to select the stealth and propulsion technologies for future integration as a low cost propulsion replacement for the Mk 54 lightweight torpedo (LWT). (Transitioned from PE 0602747N) - Continued LTT feasibility investigations and selected geo-coordinate based navigation system technologies and connectivity methods (i.e. acoustic communications, fiber link) for future development of technologies for LWT demonstration). (Transitioned from PE 0602747N) - Continued data collection for LWT broadband and counter-countermeasures in the harsh shallow water environment of the Shore Bombardment Area site off the Southern California Off-Shore Range using an experimental test vehicle fitted with a broadband Mk 54 array. (Transitioned from PE 0602747N) - Continued LTT sensor package development to achieve integrated coherent broadband sonar and novel adjunct sensors homing and classification capabilities for LWT. (Transitioned from PE 0602747N) - Continued LTT advanced counter-countermeasure algorithm and tactics development for LWT. (Transitioned from PE 0602747N) - Continued feasibility assessment of LTT to best utilize precision targeting and distributed sensors for weapon employment from high altitude and standoff range. (Transitioned from PE 0602747N)				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY		PROJECT NUMBER 2916		
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

- Continued development and integration of adjunct sensors into a lightweight torpedo sensor and design signal processing and data fusion techniques to improve target classification in areas of high contact density. (Transitioned from PE 0602747N)
- Continued a high fidelity weapon frequency model development effort to parallel adjunct sensor developments and provide accurate synthetic data for algorithm design and measurement. (Transitioned from PE 0602747N)
- Completed LTT feasibility investigations addressing adjunct sensor configurations, stealth and propulsion technologies, and geo-coordinate based navigation systems. (Transitioned from PE 0602747N)
- Initiated in-water data collection for development of advanced counter countermeasure processing, weapon-to-weapon acoustic communication and a salvo vehicle intelligent controller.
- Initiated development of a high channel count LTT broadband transmitter.
- Initiated development and integration of a total LTT system prototype in the Mk 54 torpedo form factor for at sea demonstrations.
- Initiated 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.
- Initiated CRAW in water data collection to support development of guidance and control algorithms enabling an ASW offensive capability in the Common Very Lightweight Torpedo.
- Initiated tests to support the development of a CRAW warhead that will achieve required performance against submarine targets, and demonstrate feasibility of achieving final goal.

FY 2009 Plans:

All efforts, except those indicated as complete below, transfer from this activity to the new Undersea Weaponry Activity in FY 2010.

- Initiate and complete LTT development, scale up and testing prototype components.
- Complete LTT advanced counter-countermeasure algorithm and tactics development for LWT.
- Initiate demonstration of LTT underwater acoustic communications capability to enable coordinated attack and net-centric connectivity. (Transitioned from PE 0602747N)

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiate demonstration of LTT weapon salvo capability utilizing behavior-based control (Transitioned from PE 0602747N) - Initiate development of an integrated LTT set-to-hit simulation capability to evaluate weapon performance gains to include robust representations of component technologies developed and demonstrated under the LTT project. - Initiate design and development of an integrated LTT full system prototype consisting of hardware and software upgrades for a final at-sea demonstration to be conducted in FY 2010. - Initiate in-water data collection on CRAW homing in presence of countermeasures.				
UNDERSEA WEAPONRY Undersea Weaponry focuses on the development of enabling technologies to counter threat submarines and surface vessels by increasing Probability of Kill (PK) and platform survivability. Weapon technology focus areas include: the Lightweight Torpedo Technologies (LTT) and the Compact Rapid Attack Weapon (CRAW) projects. The ultimate goal of this activity is to provide revolutionary capabilities needed to fill Sea Shield Warfighter Capability Gaps, to accommodate unique payload limitations through the development of modular and reduced sized undersea weapons based on common technology enablers (where possible), and to provide improved submarine cuing/wide area search in deep and shallow water ocean areas while providing the capability to rapidly transition the submarine mission to engagement/neutralization. The FY 2009 to FY 2010 funding increase is due to the realignment of the Neutralization activity into this new activity. *FY 2010 Plans:* The following efforts transferred to this activity from the FY 2009 Neutralization activity: - Continue 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. - Continue CRAW in water data collection to support development of guidance and control algorithms enabling an ASW offensive capability in the Common Very Lightweight Torpedo.	0.000	0.000	13.492	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Continue tests to support the development of a CRAW warhead that will achieve required performance against submarine targets, and demonstrate feasibility of achieving final goal. - Continue in-water data collection on CRAW homing in presence of countermeasures. - Complete LTT feasibility investigations to select the stealth and propulsion technologies for future integration as a low cost propulsion replacement for the Mk 54 lightweight torpedo (LWT). - Complete further development of advanced fusing technology for LWT started in FY09 as part of the LTT FNC project. - Complete LTT feasibility investigations and selected geo-coordinate based navigation system technologies and connectivity methods (i.e. acoustic communications, fiber link) for future development of technologies for LWT demonstration). - Complete data collection for LWT broadband and counter-countermeasures in the harsh shallow water environment of the Shore Bombardment Area site off the Southern California Off-Shore Range using an experimental test vehicle fitted with a broadband Mk 54 array. - Complete LTT sensor package development to achieve integrated coherent broadband sonar and novel acoustic sensors for homing and classification capabilities for LWT. - Complete feasibility assessment of LTT to best utilize precision targeting and distributed sensors for weapon employment from high altitude and standoff range. - Complete in-water data collection for development of advanced counter countermeasure processing. - Complete development of a high channel count LTT broadband transmitter. - Complete development and integration of a total LTT system prototype in the Mk 54 torpedo form factor for at sea demonstrations. - Complete development of an integrated LTT set-to-hit simulation capability to evaluate weapon performance gains to include robust representations of component technologies developed and demonstrated under the LTT project. - Complete design and development of an integrated LTT full system prototype consisting of hardware and software upgrades for final at-sea demonstrations to be conducted in FY 2010. - Initiate and complete at-sea demonstration and assessment of LTT full system prototype. - Transition demonstrated Lightweight Torpedo Technologies to PE 0604610N (Lightweight Torpedo Development).				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Due to a realignment of priorities the following efforts were completed/ended in FY2009: - LTT integration of broadband and adjunct sensors for in-water data collection to result in a new dual-mode sensor guidance and control system for at-sea testing. - Feasibility investigations under LTT to quantify adjunct sensor configurations and signal processing approaches to enable positive discrimination of artificial targets at standoff ranges. This feasibility investigation is expected to result in five (5) new patent applications. - LTT sensor package development to achieve integrated coherent broadband sonar and novel adjunct sensors homing and classification capabilities for LWT. - Development and integration of adjunct sensors into a lightweight torpedo sensor and design signal processing and data fusion techniques to improve target classification in areas of high contact density. - In-water data collection for development of advanced counter countermeasure processing, weapon-to-weapon acoustic communication and a salvo vehicle intelligent controller. - Demonstration of LTT underwater acoustic communications capability to enable coordinated attack and net-centric connectivity. - Demonstration of LTT weapon salvo capability utilizing behavior-based control.				
WIDE AREA ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE 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.	50.578	60.503	0.000	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
The FY 2008 to FY 2009 increase represents the net effect of the phased movement of technologies from Applied (6.2) to Advanced (6.3) Research as the technologies mature and prepare for transition to acquisition. Additionally, the increase in Wide Area ASW Surveillance supports a basic shift in Naval strategy away from platform-based undersea surveillance systems toward deployable, distributed systems. The FY 2009 to FY 2010 funding decrease is due to the realignment of efforts in this activity to the newly established ASW Distributed Search; ASW Surveillance; and Performance Assessment activities respectively. *FY 2008 Accomplishments:* - Continued STT-Baseline advanced research efforts in the areas of advanced undersea sensors, communications, autonomy, and sensor data collection and analysis to support tracking algorithm and automated processing development. - Continued DADS deployability, survivability and classification performance improvement effort. - Continued testing of the Palantir (a non-acoustic surveillance system) sensor system. The related test planning is conducted in PE 0602747N. - Continued tactical test planning for the Palantir sensor. - Continued development of active sonar sensors and processing for wide area surveillance of deep ocean operating areas. - Completed integration of STT sensors with undersea submersibles. - Completed all Littoral ASW Multistatic Project efforts for CDMR, CDMS, and development of multistatic signal processing algorithms and transition products to PMA-264, Air Anti-Submarine Warfare Assault and Special Missions Program Office, PE 0603254N, Project 1292. - Completed development of and test an experimental design model of a Deep Water Active Deployable System (DWADS) for surveillance of deep ocean submarine threats. - Initiated DADS at-sea classification performance improvement testing. - Initiated at-sea testing of integrated STT submersibles and evaluate overall system performance. - Initiated integration and evaluation of STT tracking algorithms and automated processing. - Initiated and complete design improvements of the Palantir sensor/data collection system and conduct an FY 2008 data collection exercise.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiated development of DSP threat submarine feature association and field tracking algorithms for active and passive distributed acoustic ASW systems. - Initiated the ODDCL effort focusing on the development of sensor and platform designs and key components compatible with a notional Concept of Operations. - Initiated development of an advanced development model of a DWADS System for surveillance of deep ocean submarine threats. - Initiated development of a tactical area prototype system for Persistent Littoral Undersea Surveillance (PLUS). This effort transferred to this PE from PE 0602747N. *FY 2009 Plans:* The following efforts transfer to the new ASW Distributed Search activity in FY 2010: - Continue development of DSP threat submarine feature association and field tracking algorithms for active and passive distributed acoustic ASW systems. The following efforts transfer to the new ASW Surveillance activity in FY 2010: - Continue STT-Baseline advanced research efforts in the areas of advanced undersea sensors, communications, autonomy, and sensor data collection and analysis to support tracking algorithm and automated processing development. - Continue DADS deployability, survivability and classification performance improvement effort. - Continue testing of the Palantir (a non-acoustic surveillance system) sensor system. - Continue tactical test planning for the Palantir sensor. - Continue DADS at-sea classification performance improvement testing. - Continue at-sea testing of integrated STT submersibles and evaluate overall system performance. - Continue the ODDCL effort focusing on the development of sensor and platform designs and key components compatible with a notional Concept of Operations. - Continue development of a tactical area prototype system for PLUS. - Initiate simulation test of the PLUS prototype system in preparation for at-sea experiments. - Initiate analysis of data collected during the PLUS at-sea experiments.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Initiate two at-sea experiments focused on increasing system persistence capabilities. - Initiate DADS deployability, covert communications and survivability testing. - Initiate system level design and integration for ODDCL. - Initiate at-sea demonstrations of STT submersible with fully integrated sensor package. The following efforts transfer to the new ASW Performance Assessment activity in FY 2010: - Initiate test planning of source algorithms to be used to determine the optimal initial placement of uncontrolled drifting distributed systems. - Initiate research effort aimed at the ideal placement and control of acoustic sources and drifting sensor systems. - Initiate a research effort focusing on distributed system in-situational environmental characterization and system monitoring. - Initiate a research effort to determine the placement of and follow-on control and pattern keeping of mobile sources and distributed sensor systems. The following efforts complete; consequently they do not transfer or continue in FY 2010: - Complete development of and demonstrate an advanced development model of a DWADS System for surveillance of deep ocean submarine threats. This project transitions to the Advanced Development for Undersea Systems Program Office (IWS 5.0) and the ASW Cross Functional Team (N874). Funding to support the transition is in PE 0603561N Project 02033. - Complete development of active sonar sensors and processing for wide area surveillance of deep ocean operating areas. - Complete integration and evaluation of STT tracking algorithms and automated processing.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0204311N/Integrated Surveillance System									Continuing	Continuing
PE 0205620N/Surface ASW Combat System Integration									Continuing	Continuing
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602235N/Common Picture Applied Research									Continuing	Continuing
PE 0602435N/Ocean Warfighting Environment Applied Research									Continuing	Continuing
PE 0602702E/Tactical Technology									Continuing	Continuing
PE 0602747N/Undersea Warfare Applied Research									Continuing	Continuing
PE 0602782N/Mine and Expeditionary Warfare Applied Research									Continuing	Continuing
PE 0603175C/Ballistic Missile Defense Technology									Continuing	Continuing
PE 0603235N/Common Picture Advanced Technology									Continuing	Continuing
PE 0603254N/ASW Systems Development									Continuing	Continuing
									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

PE 0603506N/Surface Ship Torpedo Defense		
PE 0603513N/Shipboard System Component Development	Continuing	Continuing
PE 0603553N/Surface ASW	Continuing	Continuing
PE 0603561N/Advanced Submarine System Development	Continuing	Continuing
PE 0603734N/CHALK CORAL	Continuing	Continuing
PE 0603739E/Advanced Electronics Technologies	Continuing	Continuing
PE 0603782N/Mine and Expeditionary Warfare Advanced Technology	Continuing	Continuing
PE 0604221N/P-3 Modernization Program	Continuing	Continuing
PE 0604261N/Acoustic Search Sensors	Continuing	Continuing
PE 0604503N/SSN-688 and Trident Modernization	Continuing	Continuing
PE 0604784N/Distributed Surveillance System	Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Improve target detection, localization, and tracking and increase attack capabilities by providing the following capabilities:
- Localization of 85% or more of enemy submarines in far forward or contested waters with false locations of less than 10% of total calls.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603747N UNDERSEA WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2916

- Effective cueing of an attack from a distance of up to 200nm.
- Improvement of the Lightweight Torpedo (Mk 54). Specific improvements are classified.
- Extending deep water active distributed system lifetime to a few months with a probability of detection (Pd) of 90% within 4 hours (field configuration) or 90% per crossing (barrier configuration), with a False Alarm Rate (FAR) of no more than 4/day.
- Delivery from a Vertical Takeoff Unmanned Air Vehicle (VTUAV) and/or a long-range, high-speed Unmanned Air Vehicle (UAV) a compact undersea weapon capable of a high Probability of Kill (PK) given precise target localization.
- Detection and localization performance with a single-line vector sensor array nominally equivalent or superior to that of two coherently processed TB-29A arrays. Acquisition costs to be competitive with the cost of a current TB-29A and at least 30% less than the cost of two arrays. Sensor and telemetry packaging will be adequate to achieve neutral buoyancy in an existing TB-29A form factor with array power efficiency greater than 75%. Array handling will be compatible with the existing TB-29 handling system.

Increase sensor to shooter performance and the effective lifetime of distributed ASW search systems by:
- Achieving a drifting active distributed system lifetime of at least two days in areas of tactical significance while maintaining required system performance with a minimum number of sensor nodes.
- Maintaining an effective lifetime of a month for mobile active distributed systems when subjected to the action of eddies from a major ocean current.
- Predicting reseed 6 hours before performance degrades.
- Holding the Area of Uncertainty (AOU) to no larger than 10 nm2 for an hour after initial detection through the control of the coherent sources.

Through a combination of better Anti-Submarine Warfare (ASW) command-level training and improved operator training provide the following:
- Improve the ability of active sonar operators to detect targets and reject potential false alarms compared to current simulation based training.
- Increase Pd by 50%.
- Provide a decrease in FAR by a factor of two.
- Provide a reduction in the probability of a hit on a High Value Unit (HVU) by a factor of two.
- Improve the ability of the ASW Commander to position assets to increase coverage, reduce active system interference and deal effectively with competing missions.
- Reduce training cost by greater than 80% and increase the frequency of training opportunities by greater than 600% relative to live training.

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603758N NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	41.100	66.138	52.643						Continuing	Continuing
2918: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS	41.100	59.955	52.643						Continuing	Continuing
9999: CONGRESSIONAL PLUS-UPS	0.000	6.183	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

This Program Element (PE) addresses the development of recent technology breakthroughs to meet current operational needs from a subscale proof-of-principle into a full-scale prototype for warfighter experimentation during laboratory and operational demonstrations, Fleet Battle Experiments (FBE), Limited Objective Experiments (LOEs) and Sea Trial Exercises. The key aspects of this PE are divided into four areas: (1) SwampWorks develops and demonstrates newly invented or recently discovered technologies that address emergent and enduring operational problems in an accelerated timeframe; (2) Naval Warfare Experimentation develops prototypes of recent technology breakthroughs and provides them to the warfighter for experimentation during FBEs, LOEs or Sea Trials; (3) Tech Solutions resolves operational problems submitted by Sailors, Marines and Science Advisors via a collaborative working environment, applies scientific applications to solve these problems, and provides the solution to the sailor for evaluation and use; and (4) Operations Analysis provides the Navy and Marine Corps the means to identify capability needs that can be addressed with science and technology solutions.

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

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603758N NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	40.612	70.216	55.988	
Current BES/President's Budget	41.100	66.138	52.643	
Total Adjustments	0.488	-4.078	-3.345	
Congressional Program Reductions		-10.243		
Congressional Rescissions				
Total Congressional Increases		6.200		
Total Reprogrammings	0.651			
SBIR/STTR Transfer	-0.163			
Program Adjustments			-3.377	
Rate/Misc Adjustments		-0.035	0.032	

Congressional Increase Details ($ in Millions)

	FY 2008	FY 2009
Project: 9999, **IMMERSIVE NAVAL OFFICER TRAINING SYSTEMS**	0.000	2.992
Project: 9999, **PORTABLE LAUNCH AND RECOVERY SYSTEM FOR UAV OPERATION FROM SMALL VESSELS**	0.000	3.191

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603758N NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS					PROJECT NUMBER 2918
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
2918: NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS	41.100	59.955	52.643						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project focuses on the development of recent technology breakthroughs to meet current operational needs from a subscale proof-of-principle into a full-scale prototype for warfighter experimentation during laboratory and operational demonstrations, FBE, LOEs and Sea Trial Exercises.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
NAVAL WARFARE EXPERIMENTATION	15.892	36.094	26.516	

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 laboratory and operational demonstrations, Sea Trials or LOEs. Current efforts include experimentation with Electronics Warfare (EW) technologies, development of test simulation technology for ship affordability, technology to advance riverine warfare operations, development and demonstration of real time situational awareness technologies, fuel cell power for unmanned air vehicles, and technology investigation studies.

The funding level increase in FY 2009 is due to additional experimentation with technologies developed in SwampWorks' power and energy initiative, the Maritime Domain Awareness (MDA) Initiative, the Operational Adaptation Technology Demonstration, and Advanced multi Function Radio Frequency Technology.

The funding level decrease in FY 2010 is due to completion of experimentation funded initially by the FY 2009 increase.

FY 2008 Accomplishments:

- Continued concept based technology program efforts.
- Continued experimentation efforts with technologies developed in SwampWorks/Tech Solutions.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603758N NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS		PROJECT NUMBER 2918		
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**

- Continued to identify other promising technology breakthroughs that can be prototyped and delivered to the warfighter for experimentation.
- Continued development and demonstration of real time situational awareness technologies.
- Continued Ship Affordability program to examine ship designs and construction processes and develop technologies that can significantly reduce the costs to conceive, design and construct naval ships.
- Continued development of AUV large sensor network for persistent pervasive surveillance.
- Completed effort to experiment and demonstrate technologies to improve warfighter survivability using electronic warfare systems.
- Completed effort to experiment and demonstrate technology for riverine warfare.
- Completed program to develop technologies to enhance vehicle tactical situational awareness and fuse with intelligence products.
- Initiated DDG-51 fuel efficient power & propulsion demonstrator effort.

FY 2009 Plans:
- Continue all FY 2008 efforts less those noted as complete above.
- Initiate and complete Maritime Domain Awareness augmentation.
- Initiate and complete effort to develop and demonstrate an integrated, affordable and minimally-manned warfighting sensor capability to provide adaptive persistent surveillance leading to Operational Adaptation by Naval forces in defeating the Asymmetric and Irregular Warfare threat.
- Initiate effort to develop and demonstrate integrated intelligence, surveillance, observation, and navigation technologies into a common operation picture accessible throughout the U.S. Government.
- Initiate effort to demonstrate shipboard high temperature degaussing technologies.
- Initiate development of network attack option models for near real time forensics and social network mapping.
- Initiate at sea laser technology experimentation.

FY 2010 Plans:
- Continue all FY 2009 efforts less those noted as complete above.
- Complete development of AUV large sensor network for persistent pervasive surveillance.
- Complete at sea laser technology experimentation.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603758N NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS	PROJECT NUMBER 2918

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete experiments to demonstrate shipboard high efficiency solid state lighting technologies. - Complete effort to demonstrate shipboard high temperature degaussing technologies. - Initiate and complete advanced coupling for integrated in line high speed generator energy storage effort. - Initiate and complete experiments to demonstrate shipboard high efficiency solid state lighting technologies. - Initiate technology experimentation for Total Ownership Cost (TOC) reduction.				
OPERATIONS ANALYSIS	2.895	2.835	2.819	
The objective of this project is to provide operational analysis through studies, analyses, gaming and experimentation to identify Navy and Marine Corps capability needs that can be addressed with Science and Technology (S&T) solutions. The effort includes core analysis of S&T programs, military utility / capability gaps analyses, war gaming and fleet experimentation analysis. Recent work includes development and execution of an MDA war game as part of an MDA Simulation Experiment (SIMEX); participation in SIMEX data collection and analysis; support of Joint Capabilities Integration Development System capabilities; development of a Code of Best Practices for Operational Experimentation; analytical, strategic planning, and wargaming support of Innovative Naval Prototype efforts; organizing and conducting workshops and symposia that increase innovative outreach; fleet operational readiness assessments; and, Red Team conceptual analysis. *FY 2008 Accomplishments:* - Continued to conduct Military Utility Analyses of future naval capability technologies. - Continued to conduct capability gaps analyses to identify areas that can be addressed with products from the science and technology portfolio. - Continued to conduct war games focused on technical issues for S&T transitions to acquisition and the fleet. *FY 2009 Plans:* - Continue all FY 2008 efforts.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603758N NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS		PROJECT NUMBER 2918		
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
FY 2010 Plans: - Continue all FY 2009 efforts.					
SWAMPWORKS 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 (POR). Examples of recent successes are the half-length torpedo which led to the development of the SwampWorks Broadband Sonar and transitioned to the Mk 48 Advanced Capability program and the Aircraft Carrier Situational Awareness System, which will be incorporated into a POR. Examples of current efforts include a high resolution sonar for the new lightweight torpedo, energy storage and reduced energy consumption technologies, coherent stand-in jammer, full ship shock test simulation, effective active acoustics simulation, and technology investigation studies. The decrease in funding in FY 2009 and out reflects cancellation of the Hypersonics effort. *FY 2008 Accomplishments:* - Continued to identify enduring and emergent operational barriers identified by naval leadership and responded with relevant technology developments and demonstrations. - Continued the development of new technologies that are responsive to Taskforce Antisubmarine Warfare (TF ASW), a recently developed Concept of Operation. - Continued an investigation and development of technologies that reduce energy consumption losses during recent operations. - Continued novel heavy fuel propulsion system development. *FY 2009 Plans:* - Continue all FY 2008 efforts. - Complete development of new technologies that are responsive to Taskforce Antisubmarine Warfare.		15.265	13.226	13.911	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603758N NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS	PROJECT NUMBER 2918

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Complete development of technologies that reduce energy consumption losses during recent operations. - Initiate and complete development of electronic warfare technologies that are responsive to fleet needs to counter emerging threats. - Initiate and complete flight deck non-skid project. - Initiate disruptive commercial technology studies at varied military, government, and educational institutions. - Initiate thermal management project. - Initiate underwater communication technology development project. *FY 2010 Plans:* - Continue all FY 2009 efforts, less those noted as completed above. - Complete thermal management project. - Complete underwater communication technology development project. - Initiate exploration of technologies to address emergent EW threats for surface and air platforms. - Initiate high risk/high payoff projects to explore significant reduction in Total Ownership Cost (TOC).				
TECH SOLUTIONS	7.048	7.800	9.397	
The objective of this program is to provide deckplate Sailors and Marines in the field with technical solutions to common operational problems and the Office of Naval Research Science Advisors with solutions to current technology gaps. The Sailors, Marines and Science Advisors provide their operational issues and technology gaps throughout the year via a collaborative online working environment. The funding increase in FY 2010 is due to the initiation and ramping up of a series of new science and technology programs focused on anti-terrorism and force protection as identified by Science Advisors and the Fleet/Force. *FY 2008 Accomplishments:* - Continued to obtain operational problems from the sailors via the web and developed, demonstrated and delivered technical solutions.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603758N NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS	PROJECT NUMBER 2918

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
- Completed immersive infantry trainer effort. - Completed portable acoustic contraband detector effort. - Completed UAV sub-launch capability effort. - Completed high performance/high sensitivity magnometer effort. - Initiated development of projects that provide solutions to problems identified by Science Advisors, as well as the Fleet/Force to address emergent critical needs. *FY 2009 Plans:* - Continue all FY 2008 efforts, less those noted as completed above. - Initiate development of projects that provide prototype solutions to problems identified by Fleet/Force members and Science Advisors to address emergent critical needs. *FY 2010 Plans:* - Continue all FY 2009 efforts. - Initiate development of projects that provide prototype solutions to problems identified by Fleet/Force members and Science Advisors to address emergent critical needs.				

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
Not applicable./Not applicable.									Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

Overall metric goals are to transition the 6.3 advanced technology projects into acquisition programs of record, demonstrate successful technologies to enable new operational concepts, and enable the production of technology products such as proofs of concept and manufacturing packages. The performance of the work funded in this PE is reviewed at several levels to ensure that the investment is relevant and productive.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603758N NAVY WARFIGHTING EXPERIMENTS AND DEMONSTRATIONS	**PROJECT NUMBER** 2918

At the macroscopic level, the investment is coordinated with Navy Warfare Development Command and Commander, Fleet Forces Command to address the goals and objectives identified for Sea Trials and LOEs.
At the microscopic level, the work funded in this PE is reviewed periodically by the Program Manager to ensure the investment is meeting the goals defined for each project. This review includes feedback collected from the warfighter community on all Sea Trials and LOE to support the Program Manager's assessment of the value and relevance of each investment. Furthermore, the entire program is reviewed yearly by the Chief of Naval Research.

THIS PAGE INTENTIONALLY LEFT BLANK

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification									DATE: May 2009	
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)					R-1 ITEM NOMENCLATURE PE 0603782N MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	28.169	34.501	28.782						Continuing	Continuing
2917: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY	26.433	33.304	28.782						Continuing	Continuing
9999: CONGRESSIONAL PLUS-UPS	1.736	1.197	0.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

The efforts described in this Program Element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (Jan 2007). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE primarily develops and demonstrates prototype Mine Countermeasures (MCM) and Expeditionary Warfare system components that support capabilities enabling Naval 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. Real world operations have demonstrated the requirement to quickly counter the mine threat. Advanced technologies must rapidly detect and neutralize all mine types, from deep water to the inland objective. This program supports the advanced development and integration of sensors, processing, warheads and delivery vehicles to demonstrate improved Naval Warfare capabilities. It supports the MCM-related Future Naval Capabilities (FNC) Enabling Capabilities (ECs). 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.

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

Exhibit R-2, PB 2010 Navy RDT&E Budget Item Justification	DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	**R-1 ITEM NOMENCLATURE** PE 0603782N MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY

B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	28.253	33.426	31.414	
Current BES/President's Budget	28.169	34.501	28.782	
Total Adjustments	-0.084	1.075	-2.632	
Congressional Program Reductions		-0.094		
Congressional Rescissions				
Total Congressional Increases		1.200		
Total Reprogrammings	0.074			
SBIR/STTR Transfer	-0.158			
Program Adjustments			-2.657	
Rate/Misc Adjustments		-0.031	0.025	

Congressional Increase Details ($ in Millions)

	FY 2008	FY 2009
Project: 9999, **JOINT EXPLOSIVE ORDNANCE DISPOSAL DIVER SITUATIONAL AWARNESS SYSTEM**	0.771	1.197
Project: 9999, **UPWARD LOOKING SONAR (ULS)**	0.965	0.000

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)				R-1 ITEM NOMENCLATURE PE 0603782N MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY					PROJECT NUMBER 2917	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
2917: MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY	26.433	33.304	28.782						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project primarily develops and demonstrates prototype MCM technologies that support a range of capabilities enabling Naval 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 operations have demonstrated the requirement to counter the projected mine threat. Advanced technologies are required to rapidly detect and neutralize all mine types, from deep water to the inland objective. This project supports the advanced development and integration of sensors, processing, warheads and delivery vehicles. It supports the MCM-related FNC ECs.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
MINE/OBSTACLE DETECTION	14.123	19.508	19.397	
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: electro-optic sensors/systems to enable Unmanned Aerial Vehicle (UAV) rapid minefield reconnaissance and precise mineline location from Very Shallow Water (VSW) through the BZ; sensors/systems to enable cooperating Unmanned Underwater Vehicles (UUVs) to perform wide-area reconnaissance and assault lane reconnaissance/preparation from shallow water through the SZ; sensor development for detection and classification of buried mines; technologies for MCM Mission Modules for the new Littoral Combat Ships (LCS); 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 MCM-related FNCs. This S&T investment supports the Joint Requirements Oversight Council of the Joint Chiefs of Staff and Office of the Chief of Naval Operations (OPNAV) validated requirements for MCM. This S&T investment of mine and obstacle detection provides critical S&T transitions to the Mine Warfare Mission package of the				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603782N MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2917

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011

Navy's new LCS. This investment in MCM S&T is reported as part of OPNAV's annual report to Congress in the MCM Certification Plan. This plan is reviewed and approved by the Office of the Secretary of Defense, and any deviations in ONR's reported S&T funding for MCM throughout the Future Years Defense Plan must be reported and justified through Navy and OSD. Further, the MCM S&T investment plan structure is reviewed and authorized by the Navy's Technology Oversight Group that approves ECs, their supporting products, and funding profiles.

The increase from FY 2008 to FY 2009 reflects the increased investment in the MCM critical S&T areas of Buried Mine Sensors and Processing; Undersea Cooperative Cueing (for UUVs); and MCM Sensors for the LCS. The FY 2009 budget reflects the transition of 6.2 applied research into advanced technology development (6.3). FY 2010 budget reflects the addition of new FNC products under Advanced Sonar Technologies for High Clearance Rate MCM.

FY 2008 Accomplishments:

- Continued advanced processing development for Low Frequency Broad Band to enable rapid detection, classification and identification of buried sea mines.
- Continued development of multi-platform fusion from high-resolution mine hunting systems (e.g. AN/AQS-20) for improved mine detection and avoidance.
- Continued development of Tactical Unmanned Aerial Vehicle (TUAV)-based SZ/BZ buried minefield detection capability.
- Continued multiple unmanned system MCM data fusion techniques for reduction in false alarms and reduction in tactical timelines.
- Continued technology development, integration and early demonstration planning for MCM Mission Module systems for Advanced Flight LCS.
- Continued transition of ROAR sensor technology to PMS-495.
- Completed demonstration of capability to enable diver teams with UUVs to efficiently and accurately reacquire previously targeted areas and individual targets.
- Completed demonstration of integrated UUV: search; marking; mapping of bathymetry, threat objects and gaps; and report back in test-bed minefields in VSW environments.

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009			
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603782N MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY			PROJECT NUMBER 2917	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
- Initiated buried mine sensing identification processing. - Initiated technology development for multiple UUV Undersea Cooperative Cueing and Intervention in support of MCM operations. *FY 2009 Plans:* - Continue all FY 2008 efforts less those noted as completed above. - Complete buried mine sensing identification processing development. - Complete development and final flight testing of ROAR system against surface laid mines and obstacles. - Initiate field testing of prototype buried mine sensors. - Initiate integration of buried mine sensors onto airborne platform and begin flight testing. - Initiate planning for assault breaching systems exercise involving the mine detection systems. *FY 2010 Plans:* - Continue all FY 2009 efforts less those noted as completed above. - Complete development of Tactical Unmanned Aerial Vehicle (TUAV)-based SZ/BZ buried minefield detection capability. - Complete field testing of prototype buried mine sensors. - Complete integration of buried mine sensors onto airborne platform and begin flight testing. - Complete technology development, integration and early demonstration planning for MCM Mission Module systems for Advanced Flight LCS. - Initiate development of iPUMA/Synthetic Aperture Sonar system to provide the first non marine mammal based mine detection and classification capability for confined or highly obstructed areas. - Initiate development of Small Acoustic Color/Imaging Sonar system to provide the first non marine mammal detection, classification and identification capability for very shallow water (VSW) and reduce the false-alarm rate by x20 for all VSW mine threats. - Initiate development of Long Range Low Frequency Broadband (LRLFBB) Sonar to significantly increase the minehunting area coverage rate. - Initiate Phase 2 of Advanced Mission Module Technology Development.				
MINE/OBSTACLE NEUTRALIZATION		12.310	13.796	9.385	

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603782N MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2917

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Mine and Obstacle Neutralization activity is focused on 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 SZ/BZ; minesweeping and jamming of sea mines; and Autonomous Underwater Vehicle (AUV) neutralization of sea mines. Stand-off breaching efforts 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) and USAF Bombers. Tactical performance of existing unitary bombs is being demonstrated. Other efforts will demonstrate a tactical countermine dart and dispenser concept. The minesweeping effort develops a mission package for deployment on Unmanned Surface Vehicles (USVs). Also, efforts will focus on improving an existing breaching weapon fuze and developing a precision assault lane marking navigation capability. This activity supports the development and transition of technologies for the MCM-related FNC ECs. The funding profile from FY 2008 to FY 2009 reflects the increased emphasis on developing FNC products in AUV technology for neutralization of sea mines, assault lane navigation and improvements to breaching weapons. The investment reduction in FY 2010 reflects the completion and transition of major programs/ projects during FY 2010. *FY 2008 Accomplishments:* - Continued development of an autonomous mine neutralization system for VSW MCM. - Continued development of advanced Mine Warfare Mission module capabilities in support of the LCS Mine Warfare mission. - Continued development effort to extend effectiveness of unitary warheads to greater depths and initiated planning of flight demo with Naval Special Clearance Team 1. - Continued technology development of precision navigation capability for targeting, safe navigation through assault lanes including lane marking. - Completed development of low drag, low frequency sound source for mine influence sweeping. - Initiated development of an AUV system for neutralization of littoral mines.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603782N MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2917

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY 2009 Plans: - Continue all FY 2008 efforts less those noted as completed above. - Initiate planning/preparation for flight demonstration of the JDAM Assault Breaching System (JABS) with tactical mines in very shallow water. - Initiate planning for assault breaching systems exercise involving the unitary warheads, precision navigation and lane marking. *FY 2010 Plans:* - Continue all FY 2009 efforts. - Complete development effort to extend effectiveness of unitary warheads to greater depths and initiated planning of flight demo with Naval Special Clearance Team 1. - Complete technology development of precision navigation capability for targeting, safe navigation through assault lanes including lane marking. - Complete flight demonstration of the JDAM Assault Breaching System (JABS) with tactical mines in very shallow water. - Complete development of an autonomous mine neutralization system for VSW MCM. - Complete development of advanced Mine Warfare Mission module capabilities in support of the LCS Mine Warfare mission. - Initiate development of autonomous behaviors to improve neutralization efficiency of littoral sea mines. - Initiate Phase 2 of Advanced Mission Module Technology Development.				

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603782N MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2917

C. Other Program Funding Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	Cost To Complete	Total Cost
PE 0601153N/Defense Research Sciences									Continuing	Continuing
PE 0602131M/Marine Corps Landing Force Technology									Continuing	Continuing
PE 0602435N/Ocean Warfighting Environment Applied Research									Continuing	Continuing
PE 0602712A/ Countermine Systems									Continuing	Continuing
PE 0602747N/Undersea Warfare Applied Research									Continuing	Continuing
PE 0602782N/Mine and Expeditionary Warfare Applied Research									Continuing	Continuing
PE 0603502N/Surface and Shallow Water Mine Countermeasures									Continuing	Continuing
PE 0603513N/Shipboard System Component Development									Continuing	Continuing
PE 0603606A/Landmine Warfare and Barrier Advanced Technology									Continuing	Continuing
PE 0603640M/USMC Advanced Technology Demonstration (ATD)									Continuing	Continuing

Exhibit R-2a, PB 2010 Navy RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 1319 - Research, Development, Test & Evaluation, Navy/BA 03 - Advanced Technology Development (ATD)	R-1 ITEM NOMENCLATURE PE 0603782N MINE AND EXPEDITIONARY WARFARE ADVANCED TECHNOLOGY	PROJECT NUMBER 2917

PE 0604373N/Airborne MCM		
PE 0604784N/Distributed Surveillance System	Continuing	Continuing

D. Acquisition Strategy

Not applicable.

E. Performance Metrics

The overall metrics of this advanced technology program are the development of technologies supporting the Mine and Expeditionary Warfare challenges of reducing the MCM tactical timeline from months to days and eliminating the need for Navy divers and manned equipment to enter minefields. Another important metric is the scheduled transition of 6.3 advanced technology projects from the FNCs program into Navy and Marine Corps acquisition programs at agreed upon Technology Readiness Levels. Technology-specific metrics include: Mine warfare data fusion capabilities yielding a 10%-25% reduction in time and risk to mine hunting activities; Mine hunting sensors - Probability of Detection = 95%, Probability of Identification of Proud Mines = 90%, Probability of Classification of Buried Mines = 80%; Unmanned Systems for MCM sized for inclusion in the Littoral Combat Ship Mine Warfare Mission Package; MCM sensors sized, packaged and capable of 12 hour missions with a search rate greater than .05 square nautical mines per hour; Mine sweeping: Modular magnetic and acoustic influence sweeping systems packaged for deployment from Unmanned Surface Vehicles; Minesweeping single sortie coverage > 9.4 square nautical miles at 20 nautical miles per hour during a 4 hour mission up to Sea State 3; Surface-laid mine and obstacle breaching capability > 90% in the Beach Zone (BZ) using unitary warheads, and > 80% in the Surf Zone (SZ).

THIS PAGE INTENTIONALLY LEFT BLANK