# Department of Defense
# Fiscal Year (FY) 2015 Budget Estimates

March 2014

## Navy

*Justification Book Volume 1*

## *Research, Development, Test & Evaluation, Navy*

## Budget Activities 1, 2, and 3

THIS PAGE INTENTIONALLY LEFT BLANK

# Table of Volumes

**Budget Activities 1, 2, and 3.....Volume 1**

**Budget Activity 4.....Volume 2**

**Budget Activity 5.....Volume 3**

**Budget Activity 6.....Volume 4**

**Budgeet Activity 7.....Volume 5**

THIS PAGE INTENTIONALLY LEFT BLANK

# Volume 1 Table of Contents

**Introduction and Explanation of Contents.....Volume 1 - v**

**Comptroller Exhibit R-1..... Volume 1 - vii**

**Master Program Element Table of Contents (by Budget Activity then Line Item Number)..... Volume 1 - xxi**

**Master Program Element Table of Contents (Alphabetically by Program Element Title)..... Volume 1 - xxxvii**

**Program Element Table of Contents (by Budget Activity then Line Item Number).....Volume 1 - xlix**

**Program Element Table of Contents (Alphabetically by Program Element Title).....Volume 1 - liii**

**Exhibit R-2's..... Volume 1 - 1**

THIS PAGE INTENTIONALLY LEFT 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, $16,266,335,000, to remain available for obligation until September 30, 2016.

THIS PAGE INTENTIONALLY LEFT BLANK

Department of Defense
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

21 Feb 2014

| Summary Recap of Budget Activities | FY 2013 (Base & OCO) | FY 2014 Base Enacted | FY 2014 OCO Enacted | FY 2014 Total Enacted | FY 2015 Base |
|---|---|---|---|---|---|
| Basic Research | 567,496 | 619,234 | | 619,234 | 576,339 |
| Applied Research | 792,372 | 859,469 | | 859,469 | 820,883 |
| Advanced Technology Development | 604,615 | 623,614 | | 623,614 | 595,014 |
| Advanced Component Development & Prototypes | 3,839,612 | 4,321,104 | | 4,321,104 | 4,591,812 |
| System Development & Demonstration | 4,896,330 | 4,250,970 | | 4,250,970 | 5,419,108 |
| Management Support | 1,103,563 | 861,314 | | 861,314 | 977,151 |
| Operational Systems Development | 3,749,489 | 3,410,624 | | 3,445,050 | 3,286,028 |
| Total Research, Development, Test & Evaluation | 15,553,477 | 14,946,329 | | 14,980,755 | 16,266,335 |
| **Summary Recap of FYDP Programs** | | | | | |
| Strategic Forces | 133,392 | 152,999 | | 152,999 | 145,185 |
| General Purpose Forces | 1,197,495 | 1,320,713 | | 1,320,713 | 1,351,064 |
| Intelligence and Communications | 1,095,183 | 659,017 | | 659,017 | 764,066 |
| Research and Development | 11,768,699 | 11,344,579 | | 11,344,579 | 12,780,652 |
| Central Supply and Maintenance | 89,222 | 83,973 | | 83,973 | 62,684 |
| Administration and Associated Activities | 2,668 | | | | |
| Classified Programs | 1,266,818 | 1,385,048 | 34,426 | 1,419,474 | 1,162,684 |
| Total Research, Development, Test & Evaluation | 15,553,477 | 14,946,329 | 34,426 | 14,980,755 | 16,266,335 |
| **Summary Recap of Non-RDT&E Title FYDP Programs** | | | | | |
| Mobility Forces | 40,137 | 44,993 | | 44,993 | |
| Total Research, Development, Test & Evaluation | 40,137 | 44,993 | | 44,993 | |

R-1C1: FY 2015 President's Budget (Published Version), as of February 21, 2014 at 08:10:30

Department of the Navy
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

21 Feb 2014

| Summary Recap of Budget Activities | FY 2013 (Base & OCO) | FY 2014 Base Enacted | FY 2014 OCO Enacted | FY 2014 Total Enacted | FY 2015 Base |
|---|---|---|---|---|---|
| Basic Research | 567,496 | 619,234 | | 619,234 | 576,339 |
| Applied Research | 792,372 | 859,469 | | 859,469 | 820,883 |
| Advanced Technology Development | 604,615 | 623,614 | | 623,614 | 595,014 |
| Advanced Component Development & Prototypes | 3,839,612 | 4,321,104 | | 4,321,104 | 4,591,812 |
| System Development & Demonstration | 4,896,330 | 4,250,970 | | 4,250,970 | 5,419,108 |
| Management Support | 1,103,563 | 861,314 | | 861,314 | 977,151 |
| Operational Systems Development | 3,749,489 | 3,410,624 | | 3,445,050 | 3,286,028 |
| Total Research, Development, Test & Evaluation | 15,553,477 | 14,946,329 | | 14,980,755 | 16,266,335 |

| Summary Recap of FYDP Programs | | | | | |
|---|---|---|---|---|---|
| Strategic Forces | 133,392 | 152,999 | | 152,999 | 145,185 |
| General Purpose Forces | 1,197,495 | 1,320,713 | | 1,320,713 | 1,351,064 |
| Intelligence and Communications | 1,095,183 | 659,017 | | 659,017 | 764,066 |
| Research and Development | 11,768,699 | 11,344,579 | | 11,344,579 | 12,780,652 |
| Central Supply and Maintenance | 89,222 | 83,973 | | 83,973 | 62,684 |
| Administration and Associated Activities | 2,668 | | | | |
| Classified Programs | 1,266,818 | 1,385,048 | 34,426 | 1,419,474 | 1,162,684 |
| Total Research, Development, Test & Evaluation | 15,553,477 | 14,946,329 | 34,426 | 14,980,755 | 16,266,335 |

R-1C1: FY 2015 President's Budget (Published Version), as of February 21, 2014 at 08:10:30

Department of the Navy
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

21 Feb 2014

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

| Line No | Program Element Number | Item | Act | FY 2013 (Base & OCO) | FY 2014 Base Enacted | FY 2014 OCO Enacted | FY 2014 Total Enacted | FY 2015 Base | Sec |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0601103N | University Research Initiatives | 01 | 117,855 | 112,617 | | 112,617 | 113,908 | U |
| 2 | 0601152N | In-House Laboratory Independent Research | 01 | 16,561 | 18,230 | | 18,230 | 18,734 | U |
| 3 | 0601153N | Defense Research Sciences | 01 | 433,080 | 488,387 | | 488,387 | 443,697 | U |
| | Basic Research | | | 567,496 | 619,234 | | 619,234 | 576,339 | |
| 4 | 0602114N | Power Projection Applied Research | 02 | 92,396 | 104,513 | | 104,513 | 95,753 | U |
| 5 | 0602123N | Force Protection Applied Research | 02 | 188,995 | 170,288 | | 170,288 | 139,496 | U |
| 6 | 0602131M | Marine Corps Landing Force Technology | 02 | 41,687 | 47,334 | | 47,334 | 45,831 | U |
| 7 | 0602235N | Common Picture Applied Research | 02 | 37,643 | 34,136 | | 34,136 | 43,541 | U |
| 8 | 0602236N | Warfighter Sustainment Applied Research | 02 | 40,162 | 49,688 | | 49,688 | 46,923 | U |
| 9 | 0602271N | Electromagnetic Systems Applied Research | 02 | 73,985 | 97,690 | | 97,690 | 107,872 | U |
| 10 | 0602435N | Ocean Warfighting Environment Applied Research | 02 | 54,912 | 45,685 | | 45,685 | 45,388 | U |
| 11 | 0602651M | Joint Non-Lethal Weapons Applied Research | 02 | 5,234 | 6,059 | | 6,059 | 5,887 | U |
| 12 | 0602747N | Undersea Warfare Applied Research | 02 | 86,091 | 103,041 | | 103,041 | 86,880 | U |
| 13 | 0602750N | Future Naval Capabilities Applied Research | 02 | 143,176 | 169,710 | | 169,710 | 170,786 | U |
| 14 | 0602782N | Mine and Expeditionary Warfare Applied Research | 02 | 28,091 | 31,325 | | 31,325 | 32,526 | U |
| | Applied Research | | | 792,372 | 859,469 | | 859,469 | 820,883 | |
| 15 | 0603114N | Power Projection Advanced Technology | 03 | 51,739 | 48,201 | | 48,201 | 37,734 | U |
| 16 | 0603123N | Force Protection Advanced Technology | 03 | 16,273 | 28,286 | | 28,286 | 25,831 | U |
| 17 | 0603271N | Electromagnetic Systems Advanced Technology | 03 | 60,098 | 56,179 | | 56,179 | 64,623 | U |
| 18 | 0603640M | USMC Advanced Technology Demonstration (ATD) | 03 | 117,288 | 132,336 | | 132,336 | 128,397 | U |
| 19 | 0603651M | Joint Non-Lethal Weapons Technology Development | 03 | 10,179 | 11,853 | | 11,853 | 11,506 | U |

R-1C1: FY 2015 President's Budget (Published Version), as of February 21, 2014 at 08:10:30

Department of the Navy
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

21 Feb 2014

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

| Line No | Program Element Number | Item | Act | FY 2013 (Base & OCO) | FY 2014 Base Enacted | FY 2014 OCO Enacted | FY 2014 Total Enacted | FY 2015 Base | Sec |
|---|---|---|---|---|---|---|---|---|---|
| 20 | 0603673N | Future Naval Capabilities Advanced Technology Development | 03 | 254,987 | 252,836 | | 252,836 | 256,144 | U |
| 21 | 0603729N | Warfighter Protection Advanced Technology | 03 | 39,086 | 40,460 | | 40,460 | 4,838 | U |
| 22 | 0603747N | Undersea Warfare Advanced Technology | 03 | 9,164 | | | | 9,985 | U |
| 23 | 0603758N | Navy Warfighting Experiments and Demonstrations | 03 | 45,801 | 51,463 | | 51,463 | 53,956 | U |
| 24 | 0603782N | Mine and Expeditionary Warfare Advanced Technology | 03 | | 2,000 | | 2,000 | 2,000 | U |
| | | Advanced Technology Development | | 604,615 | 623,614 | | 623,614 | 595,014 | |
| 25 | 0603207N | Air/Ocean Tactical Applications | 04 | 31,357 | 39,246 | | 39,246 | 40,429 | U |
| 26 | 0603216N | Aviation Survivability | 04 | 7,970 | 5,591 | | 5,591 | 4,325 | U |
| 27 | 0603237N | Deployable Joint Command and Control | 04 | 3,451 | 3,262 | | 3,262 | 2,991 | U |
| 28 | 0603251N | Aircraft Systems | 04 | 21,829 | 10,074 | | 10,074 | 12,651 | U |
| 29 | 0603254N | ASW Systems Development | 04 | 7,306 | 6,964 | | 6,964 | 7,782 | U |
| 30 | 0603261N | Tactical Airborne Reconnaissance | 04 | 4,812 | 5,257 | | 5,257 | 5,275 | U |
| 31 | 0603382N | Advanced Combat Systems Technology | 04 | 1,345 | 1,563 | | 1,563 | 1,646 | U |
| 32 | 0603502N | Surface and Shallow Water Mine Countermeasures | 04 | 160,710 | 160,040 | | 160,040 | 100,349 | U |
| 33 | 0603506N | Surface Ship Torpedo Defense | 04 | 83,709 | 85,649 | | 85,649 | 52,781 | U |
| 34 | 0603512N | Carrier Systems Development | 04 | 97,668 | 80,899 | | 80,899 | 5,959 | U |
| 35 | 0603525N | PILOT FISH | 04 | 91,528 | 108,713 | | 108,713 | 148,865 | U |
| 36 | 0603527N | RETRACT LARCH | 04 | 75,517 | 9,316 | | 9,316 | 25,365 | U |
| 37 | 0603536N | RETRACT JUNIPER | 04 | 82,694 | 77,108 | | 77,108 | 80,477 | U |
| 38 | 0603542N | Radiological Control | 04 | 706 | 762 | | 762 | 669 | U |
| 39 | 0603553N | Surface ASW | 04 | 3,841 | 2,349 | | 2,349 | 1,060 | U |

R-1C1: FY 2015 President's Budget (Published Version), as of February 21, 2014 at 08:10:30

Department of the Navy
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

21 Feb 2014

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

| Line No | Program Element Number | Item | Act | FY 2013 (Base & OCO) | FY 2014 Base Enacted | FY 2014 OCO Enacted | FY 2014 Total Enacted | FY 2015 Base | Sec |
|---|---|---|---|---|---|---|---|---|---|
| 40 | 0603561N | Advanced Submarine System Development | 04 | 500,161 | 850,062 | | 850,062 | 70,551 | U |
| 41 | 0603562N | Submarine Tactical Warfare Systems | 04 | 8,505 | 8,764 | | 8,764 | 8,044 | U |
| 42 | 0603563N | Ship Concept Advanced Design | 04 | 22,193 | 17,501 | | 17,501 | 17,864 | U |
| 43 | 0603564N | Ship Preliminary Design & Feasibility Studies | 04 | 35,737 | 38,117 | | 38,117 | 23,716 | U |
| 44 | 0603570N | Advanced Nuclear Power Systems | 04 | 228,861 | 428,933 | | 428,933 | 499,961 | U |
| 45 | 0603573N | Advanced Surface Machinery Systems | 04 | 26,642 | 18,144 | | 18,144 | 21,026 | U |
| 46 | 0603576N | CHALK EAGLE | 04 | 453,935 | 518,804 | | 518,804 | 542,700 | U |
| 47 | 0603581N | Littoral Combat Ship (LCS) | 04 | 374,966 | 210,217 | | 210,217 | 88,734 | U |
| 48 | 0603582N | Combat System Integration | 04 | 45,131 | 4,396 | | 4,396 | 20,881 | U |
| 49 | 0603595N | Ohio Replacement | 04 | | | | | 849,277 | U |
| 50 | 0603596N | LCS Mission Modules | 04 | | 161,771 | | 161,771 | 196,948 | U |
| 51 | 0603597N | Automated Test and Re-Test (ATRT) | 04 | | 10,005 | | 10,005 | 8,115 | U |
| 52 | 0603609N | Conventional Munitions | 04 | 6,717 | 8,404 | | 8,404 | 7,603 | U |
| 53 | 0603611M | Marine Corps Assault Vehicles | 04 | 83,182 | 122,967 | | 122,967 | 105,749 | U |
| 54 | 0603635M | Marine Corps Ground Combat/Support System | 04 | 8,400 | 1,489 | | 1,489 | 1,342 | U |
| 55 | 0603654N | Joint Service Explosive Ordnance Development | 04 | 41,468 | 34,958 | | 34,958 | 21,399 | U |
| 56 | 0603658N | Cooperative Engagement | 04 | 50,058 | 53,572 | | 53,572 | 43,578 | U |
| 57 | 0603713N | Ocean Engineering Technology Development | 04 | 6,370 | 7,696 | | 7,696 | 7,764 | U |
| 58 | 0603721N | Environmental Protection | 04 | 19,194 | 18,850 | | 18,850 | 13,200 | U |
| 59 | 0603724N | Navy Energy Program | 04 | 85,577 | 45,618 | | 45,618 | 69,415 | U |
| 60 | 0603725N | Facilities Improvement | 04 | 3,116 | 3,019 | | 3,019 | 2,588 | U |

R-1C1: FY 2015 President's Budget (Published Version), as of February 21, 2014 at 08:10:30

Department of the Navy
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

21 Feb 2014

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

| Line No | Program Element Number | Item | Act | FY 2013 (Base & OCO) | FY 2014 Base Enacted | FY 2014 OCO Enacted | FY 2014 Total Enacted | FY 2015 Base | Sec |
|---|---|---|---|---|---|---|---|---|---|
| 61 | 0603734N | CHALK CORAL | 04 | 41,498 | 124,451 | | 124,451 | 176,301 | U |
| 62 | 0603739N | Navy Logistic Productivity | 04 | 3,452 | 3,847 | | 3,847 | 3,873 | U |
| 63 | 0603746N | RETRACT MAPLE | 04 | 290,796 | 308,131 | | 308,131 | 376,028 | U |
| 64 | 0603748N | LINK PLUMERIA | 04 | 153,811 | 121,189 | | 121,189 | 272,096 | U |
| 65 | 0603751N | RETRACT ELM | 04 | 115,681 | 56,358 | | 56,358 | 42,233 | U |
| 66 | 0603764N | LINK EVERGREEN | 04 | 61,986 | 55,378 | | 55,378 | 46,504 | U |
| 67 | 0603787N | Special Processes | 04 | 43,810 | 48,842 | | 48,842 | 25,109 | U |
| 68 | 0603790N | NATO Research and Development | 04 | 8,589 | 7,502 | | 7,502 | 9,659 | U |
| 69 | 0603795N | Land Attack Technology | 04 | 14,274 | | | | 318 | U |
| 70 | 0603851M | Joint Non-Lethal Weapons Testing | 04 | 41,191 | 49,278 | | 49,278 | 40,912 | U |
| 71 | 0603860N | Joint Precision Approach and Landing Systems - Dem/Val | 04 | 120,491 | 156,178 | | 156,178 | 54,896 | U |
| 72 | 0603889N | Counterdrug RDT&E Projects | 04 | 500 | | | | | U |
| 73 | 0603925N | Directed Energy and Electric Weapon Systems | 04 | | | | | 58,696 | U |
| 74 | 0604112N | Gerald R. Ford Class Nuclear Aircraft Carrier (CVN 78 - 80) | 04 | | | | | 43,613 | U |
| 75 | 0604122N | Remote Minehunting System (RMS) | 04 | | | | | 21,110 | U |
| 76 | 0604272N | Tactical Air Directional Infrared Countermeasures (TADIRCM) | 04 | 66,196 | 33,906 | | 33,906 | 5,657 | U |
| 77 | 0604279N | ASE Self-Protection Optimization | 04 | 725 | 169 | | 169 | 8,033 | U |
| 78 | 0604454N | LX (R) | 04 | | | | | 36,859 | U |
| 79 | 0604653N | Joint Counter Radio Controlled IED Electronic Warfare (JCREW) | 04 | 42,421 | 15,874 | | 15,874 | 15,227 | U |
| 80 | 0604659N | Precision Strike Weapons Development Program | 04 | 5,166 | 2,257 | | 2,257 | | U |

R-1C1: FY 2015 President's Budget (Published Version), as of February 21, 2014 at 08:10:30

Department of the Navy
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

21 Feb 2014

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

| Line No | Program Element Number | Item | Act | FY 2013 (Base & OCO) | FY 2014 Base Enacted | FY 2014 OCO Enacted | FY 2014 Total Enacted | FY 2015 Base | Sec |
|---|---|---|---|---|---|---|---|---|---|
| 81 | 0604707N | Space and Electronic Warfare (SEW) Architecture/Engineering Support | 04 | 26,279 | 31,256 | | 31,256 | 22,393 | U |
| 82 | 0604786N | Offensive Anti-Surface Warfare Weapon Development | 04 | 77,609 | 90,985 | | 90,985 | 202,939 | U |
| 83 | 0605812M | Joint Light Tactical Vehicle (JLTV) Engineering and Manufacturing Development Ph | 04 | 35,563 | 50,362 | | 50,362 | 11,450 | U |
| 84 | 0303354N | ASW Systems Development - MIP | 04 | 12,077 | 4,908 | | 4,908 | 6,495 | U |
| 85 | 0304270N | Electronic Warfare Development - MIP | 04 | 2,841 | 153 | | 153 | 332 | U |
| | | Advanced Component Development & Prototypes | | 3,839,612 | 4,321,104 | | 4,321,104 | 4,591,812 | |
| 86 | 0603208N | Training System Aircraft | 05 | | | | | 25,153 | U |
| 87 | 0604212N | Other Helo Development | 05 | 22,899 | 25,458 | | 25,458 | 46,154 | U |
| 88 | 0604214N | AV-8B Aircraft - Eng Dev | 05 | 16,128 | 33,325 | | 33,325 | 25,372 | U |
| 89 | 0604215N | Standards Development | 05 | 67,801 | 68,497 | | 68,497 | 53,712 | U |
| 90 | 0604216N | Multi-Mission Helicopter Upgrade Development | 05 | 6,035 | 17,565 | | 17,565 | 11,434 | U |
| 91 | 0604218N | Air/Ocean Equipment Engineering | 05 | 3,658 | 4,026 | | 4,026 | 2,164 | U |
| 92 | 0604221N | P-3 Modernization Program | 05 | 3,170 | 791 | | 791 | 1,710 | U |
| 93 | 0604230N | Warfare Support System | 05 | 9,983 | 9,725 | | 9,725 | 9,094 | U |
| 94 | 0604231N | Tactical Command System | 05 | 65,416 | 63,438 | | 63,438 | 70,248 | U |
| 95 | 0604234N | Advanced Hawkeye | 05 | 125,194 | 107,041 | | 107,041 | 193,200 | U |
| 96 | 0604245N | H-1 Upgrades | 05 | 27,724 | 47,123 | | 47,123 | 44,115 | U |
| 97 | 0604261N | Acoustic Search Sensors | 05 | 32,507 | 29,195 | | 29,195 | 23,227 | U |
| 98 | 0604262N | V-22A | 05 | 44,294 | 43,084 | | 43,084 | 61,249 | U |
| 99 | 0604264N | Air Crew Systems Development | 05 | 2,437 | 9,151 | | 9,151 | 15,014 | U |

R-1C1: FY 2015 President's Budget (Published Version), as of February 21, 2014 at 08:10:30

Department of the Navy
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

21 Feb 2014

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

| Line No | Program Element Number | Item | Act | FY 2013 (Base & OCO) | FY 2014 Base Enacted | FY 2014 OCO Enacted | FY 2014 Total Enacted | FY 2015 Base | Sec |
|---|---|---|---|---|---|---|---|---|---|
| 100 | 0604269N | EA-18 | 05 | 11,769 | 11,138 | | 11,138 | 18,730 | U |
| 101 | 0604270N | Electronic Warfare Development | 05 | 46,851 | 34,964 | | 34,964 | 28,742 | U |
| 102 | 0604273N | Executive Helo Development | 05 | 46,203 | 94,235 | | 94,235 | 388,086 | U |
| 103 | 0604274N | Next Generation Jammer (NGJ) | 05 | 153,369 | 157,796 | | 157,796 | 246,856 | U |
| 104 | 0604280N | Joint Tactical Radio System - Navy (JTRS-Navy) | 05 | 197,819 | 3,259 | | 3,259 | 7,106 | U |
| 105 | 0604307N | Surface Combatant Combat System Engineering | 05 | 232,441 | 206,298 | | 206,298 | 189,112 | U |
| 106 | 0604311N | LPD-17 Class Systems Integration | 05 | 741 | 1,214 | | 1,214 | 376 | U |
| 107 | 0604329N | Small Diameter Bomb (SDB) | 05 | 28,883 | 24,925 | | 24,925 | 71,849 | U |
| 108 | 0604366N | Standard Missile Improvements | 05 | 46,966 | 67,082 | | 67,082 | 53,198 | U |
| 109 | 0604373N | Airborne MCM | 05 | 60,424 | 109,354 | | 109,354 | 38,941 | U |
| 110 | 0604376M | Marine Air Ground Task Force (MAGTF) Electronic Warfare (EW) for Aviation | 05 | 9,647 | 10,080 | | 10,080 | 7,832 | U |
| 111 | 0604378N | Naval Integrated Fire Control - Counter Air Systems Engineering | 05 | 35,872 | 21,413 | | 21,413 | 15,263 | U |
| 112 | 0604404N | Unmanned Carrier Launched Airborne Surveillance and Strike (UCLASS) System | 05 | 99,479 | 121,673 | | 121,673 | 403,017 | U |
| 113 | 0604501N | Advanced Above Water Sensors | 05 | 235,176 | 157,871 | | 157,871 | 20,409 | U |
| 114 | 0604503N | SSN-688 and Trident Modernization | 05 | 74,091 | 85,711 | | 85,711 | 71,565 | U |
| 115 | 0604504N | Air Control | 05 | 5,231 | 10,754 | | 10,754 | 29,037 | U |
| 116 | 0604512N | Shipboard Aviation Systems | 05 | 58,179 | 69,615 | | 69,615 | 122,083 | U |
| 117 | 0604518N | Combat Information Center Conversion | 05 | 817 | | | | | U |
| 118 | 0604522N | Advanced Missile Defense Radar (AMDR) System | 05 | | | | | 144,706 | U |
| 119 | 0604558N | New Design SSN | 05 | 81,162 | 62,446 | | 62,446 | 72,695 | U |

R-1C1: FY 2015 President's Budget (Published Version), as of February 21, 2014 at 08:10:30

Department of the Navy
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

21 Feb 2014

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

| Line No | Program Element Number | Item | Act | FY 2013 (Base & OCO) | FY 2014 Base Enacted | FY 2014 OCO Enacted | FY 2014 Total Enacted | FY 2015 Base | Sec |
|---|---|---|---|---|---|---|---|---|---|
| 120 | 0604562N | Submarine Tactical Warfare System | 05 | 43,555 | 49,135 | | 49,135 | 38,985 | U |
| 121 | 0604567N | Ship Contract Design/ Live Fire T&E | 05 | 165,908 | 187,421 | | 187,421 | 48,470 | U |
| 122 | 0604574N | Navy Tactical Computer Resources | 05 | 3,552 | 3,689 | | 3,689 | 3,935 | U |
| 123 | 0604580N | Virginia Payload Module (VPM) | 05 | | 59,120 | | 59,120 | 132,602 | U |
| 124 | 0604601N | Mine Development | 05 | 6,934 | 5,041 | | 5,041 | 19,067 | U |
| 125 | 0604610N | Lightweight Torpedo Development | 05 | 45,907 | 26,444 | | 26,444 | 25,280 | U |
| 126 | 0604654N | Joint Service Explosive Ordnance Development | 05 | 7,394 | 8,897 | | 8,897 | 8,985 | U |
| 127 | 0604703N | Personnel, Training, Simulation, and Human Factors | 05 | 5,224 | 4,233 | | 4,233 | 7,669 | U |
| 128 | 0604727N | Joint Standoff Weapon Systems | 05 | 5,490 | 442 | | 442 | 4,400 | U |
| 129 | 0604755N | Ship Self Defense (Detect & Control) | 05 | 78,227 | 95,604 | | 95,604 | 56,889 | U |
| 130 | 0604756N | Ship Self Defense (Engage: Hard Kill) | 05 | 52,816 | 43,303 | | 43,303 | 96,937 | U |
| 131 | 0604757N | Ship Self Defense (Engage: Soft Kill/EW) | 05 | 125,204 | 114,799 | | 114,799 | 134,564 | U |
| 132 | 0604761N | Intelligence Engineering | 05 | | 1,984 | | 1,984 | 200 | U |
| 133 | 0604771N | Medical Development | 05 | 37,426 | 28,458 | | 28,458 | 8,287 | U |
| 134 | 0604777N | Navigation/ID System | 05 | 38,949 | 47,428 | | 47,428 | 29,504 | U |
| 135 | 0604800M | Joint Strike Fighter (JSF) - EMD | 05 | 639,059 | 415,727 | | 415,727 | 513,021 | U |
| 136 | 0604800N | Joint Strike Fighter (JSF) - EMD | 05 | 642,349 | 440,745 | | 440,745 | 516,456 | U |
| 137 | 0605013M | Information Technology Development | 05 | 11,540 | 5,564 | | 5,564 | 2,887 | U |
| 138 | 0605013N | Information Technology Development | 05 | 64,238 | 47,807 | | 47,807 | 66,317 | U |
| 139 | 0605212N | CH-53K RDTE | 05 | 535,552 | 462,280 | | 462,280 | 573,187 | U |
| 140 | 0605220N | Ship to Shore Connector (SSC) | 05 | | | | | 67,815 | U |

R-1C1: FY 2015 President's Budget (Published Version), as of February 21, 2014 at 08:10:30

Department of the Navy
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

21 Feb 2014

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

| Line No | Program Element Number | Item | Act | FY 2013 (Base & OCO) | FY 2014 Base Enacted | FY 2014 OCO Enacted | FY 2014 Total Enacted | FY 2015 Base | Sec |
|---|---|---|---|---|---|---|---|---|---|
| 141 | 0605450N | Joint Air-to-Ground Missile (JAGM) | 05 | | | | | 6,300 | U |
| 142 | 0605500N | Multi-mission Maritime Aircraft (MMA) | 05 | 391,364 | 272,352 | | 272,352 | 308,037 | U |
| 143 | 0204202N | DDG-1000 | 05 | 120,842 | 187,904 | | 187,904 | 202,522 | U |
| 144 | 0304231N | Tactical Command System - MIP | 05 | 1,072 | 2,140 | | 2,140 | 1,011 | U |
| 145 | 0304785N | Tactical Cryptologic Systems | 05 | 21,362 | 9,406 | | 9,406 | 10,357 | U |
| 146 | 0305124N | Special Applications Program | 05 | | 22,800 | | 22,800 | 23,975 | U |
| | | System Development & Demonstration | | 4,896,330 | 4,250,970 | | 4,250,970 | 5,419,108 | |
| 147 | 0604256N | Threat Simulator Development | 06 | 27,843 | 43,261 | | 43,261 | 45,272 | U |
| 148 | 0604258N | Target Systems Development | 06 | 53,171 | 71,872 | | 71,872 | 79,718 | U |
| 149 | 0604759N | Major T&E Investment | 06 | 32,989 | 38,033 | | 38,033 | 123,993 | U |
| 150 | 0605126N | Joint Theater Air and Missile Defense Organization | 06 | 5,829 | 1,352 | | 1,352 | 4,960 | U |
| 151 | 0605152N | Studies and Analysis Support - Navy | 06 | 15,996 | 5,553 | | 5,553 | 8,296 | U |
| 152 | 0605154N | Center for Naval Analyses | 06 | 41,573 | 46,655 | | 46,655 | 45,752 | U |
| 153 | 0605502N | Small Business Innovative Research | 06 | 289,844 | | | | | U |
| 154 | 0605804N | Technical Information Services | 06 | 1,230 | 637 | | 637 | 876 | U |
| 155 | 0605853N | Management, Technical & International Support | 06 | 44,635 | 83,494 | | 83,494 | 72,070 | U |
| 156 | 0605856N | Strategic Technical Support | 06 | 2,935 | 3,221 | | 3,221 | 3,237 | U |
| 157 | 0605861N | RDT&E Science and Technology Management | 06 | 64,317 | 72,725 | | 72,725 | 73,033 | U |
| 158 | 0605863N | RDT&E Ship and Aircraft Support | 06 | 130,840 | 141,778 | | 141,778 | 138,304 | U |
| 159 | 0605864N | Test and Evaluation Support | 06 | 341,126 | 301,219 | | 301,219 | 336,286 | U |
| 160 | 0605865N | Operational Test and Evaluation Capability | 06 | 15,109 | 16,565 | | 16,565 | 16,658 | U |

R-1C1: FY 2015 President's Budget (Published Version), as of February 21, 2014 at 08:10:30

Department of the Navy
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

21 Feb 2014

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

| Line No | Program Element Number | Item | Act | FY 2013 (Base & OCO) | FY 2014 Base Enacted | FY 2014 OCO Enacted | FY 2014 Total Enacted | FY 2015 Base | Sec |
|---|---|---|---|---|---|---|---|---|---|
| 161 | 0605866N | Navy Space and Electronic Warfare (SEW) Support | 06 | 6,091 | 3,264 | | 3,264 | 2,505 | U |
| 162 | 0605867N | SEW Surveillance/Reconnaissance Support | 06 | 7,453 | 7,134 | | 7,134 | 8,325 | U |
| 163 | 0605873M | Marine Corps Program Wide Support | 06 | 17,352 | 24,054 | | 24,054 | 17,866 | U |
| 164 | 0305885N | Tactical Cryptologic Activities | 06 | 2,562 | 497 | | 497 | | U |
| 165 | 0909999N | Financing for Cancelled Account Adjustments | 06 | 2,668 | | | | | U |
| | | Management Support | | 1,103,563 | 861,314 | | 861,314 | 977,151 | |
| 167 | 0604227N | HARPOON Modifications | 07 | | 699 | | 699 | | U |
| 168 | 0604402N | Unmanned Combat Air Vehicle (UCAV) Advanced Component and Prototype Development | 07 | 128,135 | 20,961 | | 20,961 | 35,949 | U |
| 169 | 0604766M | Marine Corps Data Systems | 07 | | 35 | | 35 | 215 | U |
| 170 | 0605525N | Carrier Onboard Delivery (COD) Follow On | 07 | | 1,230 | | 1,230 | 8,873 | U |
| 171 | 0605555N | Strike Weapons Development | 07 | | 13,757 | | 13,757 | | U |
| 172 | 0101221N | Strategic Sub & Weapons System Support | 07 | 83,771 | 98,057 | | 98,057 | 96,943 | U |
| 173 | 0101224N | SSBN Security Technology Program | 07 | 30,861 | 31,755 | | 31,755 | 30,057 | U |
| 174 | 0101226N | Submarine Acoustic Warfare Development | 07 | 1,299 | 1,464 | | 1,464 | 4,509 | U |
| 175 | 0101402N | Navy Strategic Communications | 07 | 17,461 | 21,723 | | 21,723 | 13,676 | U |
| 176 | 0203761N | Rapid Technology Transition (RTT) | 07 | 21,906 | 8,561 | | 8,561 | 12,480 | U |
| 177 | 0204136N | F/A-18 Squadrons | 07 | 150,477 | 112,618 | | 112,618 | 76,216 | U |
| 178 | 0204152N | E-2 Squadrons | 07 | 7,871 | 1,971 | | 1,971 | | U |
| 179 | 0204163N | Fleet Telecommunications (Tactical) | 07 | 14,304 | 23,422 | | 23,422 | 27,281 | U |
| 180 | 0204228N | Surface Support | 07 | 2,999 | 2,374 | | 2,374 | 2,878 | U |

R-1C1: FY 2015 President's Budget (Published Version), as of February 21, 2014 at 08:10:30

Department of the Navy
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

21 Feb 2014

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

| Line No | Program Element Number | Item | Act | FY 2013 (Base & OCO) | FY 2014 Base Enacted | FY 2014 OCO Enacted | FY 2014 Total Enacted | FY 2015 Base | Sec |
|---|---|---|---|---|---|---|---|---|---|
| 181 | 0204229N | Tomahawk and Tomahawk Mission Planning Center (TMPC) | 07 | 10,154 | 12,407 | | 12,407 | 32,385 | U |
| 182 | 0204311N | Integrated Surveillance System | 07 | 40,658 | 41,609 | | 41,609 | 39,371 | U |
| 183 | 0204413N | Amphibious Tactical Support Units (Displacement Craft) | 07 | 6,091 | 4,382 | | 4,382 | 4,609 | U |
| 184 | 0204460M | Ground/Air Task Oriented Radar (G/ATOR) | 07 | 70,217 | 78,208 | | 78,208 | 99,106 | U |
| 185 | 0204571N | Consolidated Training Systems Development | 07 | 16,798 | 39,124 | | 39,124 | 39,922 | U |
| 186 | 0204574N | Cryptologic Direct Support | 07 | 1,610 | 2,703 | | 2,703 | 1,157 | U |
| 187 | 0204575N | Electronic Warfare (EW) Readiness Support | 07 | 17,867 | 19,563 | | 19,563 | 22,067 | U |
| 188 | 0205601N | HARM Improvement | 07 | 12,586 | 13,586 | | 13,586 | 17,420 | U |
| 189 | 0205604N | Tactical Data Links | 07 | 79,362 | 169,875 | | 169,875 | 151,208 | U |
| 190 | 0205620N | Surface ASW Combat System Integration | 07 | 24,465 | 31,863 | | 31,863 | 26,366 | U |
| 191 | 0205632N | MK-48 ADCAP | 07 | 35,115 | 10,080 | | 10,080 | 25,952 | U |
| 192 | 0205633N | Aviation Improvements | 07 | 71,945 | 78,608 | | 78,608 | 106,936 | U |
| 193 | 0205658N | Navy Science Assistance Program | 07 | 3,131 | | | | | U |
| 194 | 0205675N | Operational Nuclear Power Systems | 07 | 79,229 | 116,928 | | 116,928 | 104,023 | U |
| 195 | 0206313M | Marine Corps Communications Systems | 07 | 162,537 | 160,773 | | 160,773 | 77,398 | U |
| 196 | 0206335M | Common Aviation Command and Control System (CAC2S) | 07 | | | | | 32,495 | U |
| 197 | 0206623M | Marine Corps Ground Combat/Supporting Arms Systems | 07 | 146,255 | 116,061 | | 116,061 | 156,626 | U |
| 198 | 0206624M | Marine Corps Combat Services Support | 07 | 56,390 | 35,647 | | 35,647 | 20,999 | U |
| 199 | 0206625M | USMC Intelligence/Electronic Warfare Systems (MIP) | 07 | 21,369 | 33,394 | | 33,394 | 14,179 | U |
| 200 | 0207161N | Tactical AIM Missiles | 07 | 18,889 | 15,453 | | 15,453 | 47,258 | U |
| 201 | 0207163N | Advanced Medium Range Air-to-Air Missile (AMRAAM) | 07 | 2,669 | 2,613 | | 2,613 | 10,210 | U |

R-1C1: FY 2015 President's Budget (Published Version), as of February 21, 2014 at 08:10:30

Department of the Navy
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

21 Feb 2014

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

| Line No | Program Element Number | Item | Act | FY 2013 (Base & OCO) | FY 2014 Base Enacted | FY 2014 OCO Enacted | FY 2014 Total Enacted | FY 2015 Base | Sec |
|---|---|---|---|---|---|---|---|---|---|
| 202 | 0208058N | Joint High Speed Vessel (JHSV) | 07 | 1,759 | 986 | | 986 | | U |
| 206 | 0303109N | Satellite Communications (SPACE) | 07 | 179,029 | 66,196 | | 66,196 | 41,829 | U |
| 207 | 0303138N | Consolidated Afloat Network Enterprise Services (CANES) | 07 | 15,510 | 24,476 | | 24,476 | 22,780 | U |
| 208 | 0303140N | Information Systems Security Program | 07 | 27,723 | 23,514 | | 23,514 | 23,053 | U |
| 209 | 0303150M | WWMCCS/Global Command and Control System | 07 | 71 | | | | 296 | U |
| 211 | 0305149N | COBRA JUDY | 07 | 14,460 | | | | | U |
| 212 | 0305160N | Navy Meteorological and Ocean Sensors-Space (METOC) | 07 | 738 | 742 | | 742 | 359 | U |
| 213 | 0305192N | Military Intelligence Program (MIP) Activities | 07 | 7,962 | 4,799 | | 4,799 | 6,166 | U |
| 214 | 0305204N | Tactical Unmanned Aerial Vehicles | 07 | 6,956 | 8,381 | | 8,381 | 8,505 | U |
| 215 | 0305207N | Manned Reconnaissance Systems | 07 | 28,099 | | | | | U |
| 216 | 0305208M | Distributed Common Ground/Surface Systems | 07 | 26,540 | 5,527 | | 5,527 | 11,613 | U |
| 217 | 0305208N | Distributed Common Ground/Surface Systems | 07 | 13,453 | 17,718 | | 17,718 | 18,146 | U |
| 218 | 0305220N | RQ-4 UAV | 07 | 612,682 | 375,235 | | 375,235 | 498,003 | U |
| 219 | 0305231N | MQ-8 UAV | 07 | 83,827 | 41,713 | | 41,713 | 47,294 | U |
| 220 | 0305232M | RQ-11 UAV | 07 | 83 | | | | 718 | U |
| 221 | 0305233N | RQ-7 UAV | 07 | 791 | 710 | | 710 | 851 | U |
| 222 | 0305234N | Small (Level 0) Tactical UAS (STUASL0) | 07 | 9,204 | 5,013 | | 5,013 | 4,813 | U |
| 223 | 0305239M | RQ-21A | 07 | 22,924 | 11,122 | | 11,122 | 8,192 | U |
| 224 | 0305241N | Multi-Intelligence Sensor Development | 07 | | 28,851 | | 28,851 | 22,559 | U |
| 225 | 0305242M | Unmanned Aerial Systems (UAS) Payloads (MIP) | 07 | | | | | 2,000 | U |
| 226 | 0308601N | Modeling and Simulation Support | 07 | 5,217 | 5,116 | | 5,116 | 4,719 | U |

R-1C1: FY 2015 President's Budget (Published Version), as of February 21, 2014 at 08:10:30

Department of the Navy
FY 2015 President's Budget
Exhibit R-1 FY 2015 President's Budget
Total Obligational Authority
(Dollars in Thousands)

21 Feb 2014

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

| Line No | Program Element Number | Item | Act | FY 2013 (Base & OCO) | FY 2014 Base Enacted | FY 2014 OCO Enacted | FY 2014 Total Enacted | FY 2015 Base | Sec |
|---|---|---|---|---|---|---|---|---|---|
| 227 | 0702207N | Depot Maintenance (Non-IF) | 07 | 20,387 | 28,042 | | 28,042 | 21,168 | U |
| 228 | 0708011N | Industrial Preparedness | 07 | 64,411 | 50,933 | | 50,933 | 37,169 | U |
| 229 | 0708730N | Maritime Technology (MARITECH) | 07 | 4,424 | 4,998 | | 4,998 | 4,347 | U |
| 9999 | 9999999999 | Classified Programs | | 1,266,818 | 1,385,048 | 34,426 | 1,419,474 | 1,162,684 | U |
| | | Operational Systems Development | | 3,749,489 | 3,410,624 | | 3,445,050 | 3,286,028 | |
| Total Research, Development, Test & Eval, Navy | | | | 15,553,477 | 14,946,329 | | 14,980,755 | 16,266,335 | |

R-1C1: FY 2015 President's Budget (Published Version), as of February 21, 2014 at 08:10:30

## Master Program Element Table of Contents (by Budget Activity then Line Item Number)

***Budget Activity 01: Basic Research***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 1 | 01 | 0601103N | University Research Initiatives | Volume 1 - 1 |
| 2 | 01 | 0601152N | In-House Lab Independent Res | Volume 1 - 7 |
| 3 | 01 | 0601153N | Defense Research Sciences | Volume 1 - 25 |


***Budget Activity 02: Applied Research***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 4 | 02 | 0602114N | Power Proj Applied Research | Volume 1 - 75 |
| 5 | 02 | 0602123N | Force Protection Applied Res | Volume 1 - 89 |
| 6 | 02 | 0602131M | Marine Corps Lndg Force Tech | Volume 1 - 111 |
| 7 | 02 | 0602235N | Common Picture Applied Research | Volume 1 - 143 |
| 8 | 02 | 0602236N | Warfighter Sustainment Applied Res | Volume 1 - 167 |
| 9 | 02 | 0602271N | Electromagnetic Systems Applied Research | Volume 1 - 187 |

***Budget Activity 02: Applied Research***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 10 | 02 | 0602435N | Ocean Wrfghtg Env Applied Res | Volume 1 - 217 |
| 11 | 02 | 0602651M | JT Non-Lethal Wpns Applied Res | Volume 1 - 233 |
| 12 | 02 | 0602747N | Undersea Warfare Applied Res | Volume 1 - 239 |
| 13 | 02 | 0602750N | (U)Future Naval Capabilities Applied Research | Volume 1 - 249 |
| 14 | 02 | 0602782N | Mine & Exp Warfare Applied Res | Volume 1 - 289 |


***Budget Activity 03: Advanced Technology Development (ATD)***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 15 | 03 | 0603114N | Power Projection Advanced Technology | Volume 1 - 297 |
| 16 | 03 | 0603123N | Force Protection Advanced Technology | Volume 1 - 303 |
| 17 | 03 | 0603271N | Electromagnetic Systems Advanced Technology | Volume 1 - 311 |
| 18 | 03 | 0603640M | MC Advanced Technology Demo | Volume 1 - 323 |
| 19 | 03 | 0603651M | JT Non-Lethal Wpns Tech Dev | Volume 1 - 361 |
| 20 | 03 | 0603673N | (U)Future Naval Capabilities Advanced Tech Dev | Volume 1 - 367 |
| 21 | 03 | 0603729N | Warfighter Protection Adv Tech | Volume 1 - 411 |

***Budget Activity 03: Advanced Technology Development (ATD)***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 22 | 03 | 0603747N | Undersea Warfare Advanced Tech | Volume 1 - 419 |
| 23 | 03 | 0603758N | Navy Warfighting Exp & Demo | Volume 1 - 425 |
| 24 | 03 | 0603782N | Mine and Expeditionary Warfare Advanced Technology | Volume 1 - 431 |


***Budget Activity 04: Advanced Component Development & Prototypes (ACD&P)***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 25 | 04 | 0603207N | Air/Ocean Tactical Applications | Volume 2 - 1 |
| 26 | 04 | 0603216N | Aviation Survivability | Volume 2 - 37 |
| 27 | 04 | 0603237N | Deployable JT Cmd & Control | Volume 2 - 53 |
| 28 | 04 | 0603251N | (U)AIRCRAFT SYSTEMS | Volume 2 - 59 |
| 29 | 04 | 0603254N | ASW Systems Development | Volume 2 - 69 |
| 30 | 04 | 0603261N | Tactical Airborne Reconnaissance | Volume 2 - 77 |
| 31 | 04 | 0603382N | Advanced Combat Systems Tech | Volume 2 - 83 |
| 32 | 04 | 0603502N | Surface & Shallow Water MCM | Volume 2 - 91 |
| 33 | 04 | 0603506N | Surface Ship Torpedo Defense | Volume 2 - 135 |

***Budget Activity 04: Advanced Component Development & Prototypes (ACD&P)***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 34 | 04 | 0603512N | Carrier Systems Development | Volume 2 - 141 |
| 35 | 04 | 0603525N | (U)PILOT FISH | Volume 2 - 161 |
| 36 | 04 | 0603527N | (U)RETRACT LARCH | Volume 2 - 163 |
| 37 | 04 | 0603536N | (U)RETRACT JUNIPER | Volume 2 - 165 |
| 38 | 04 | 0603542N | Radiological Control | Volume 2 - 167 |
| 39 | 04 | 0603553N | Surface ASW | Volume 2 - 193 |
| 40 | 04 | 0603561N | Advanced Submarine System Development | Volume 2 - 201 |
| 41 | 04 | 0603562N | Submarine Tactical Warfare Sys | Volume 2 - 225 |
| 42 | 04 | 0603563N | Ship Concept Advanced Design | Volume 2 - 235 |
| 43 | 04 | 0603564N | Ship Prel Design & Feasibility Studies | Volume 2 - 251 |
| 44 | 04 | 0603570N | Advanced Nuclear Power Systems | Volume 2 - 279 |
| 45 | 04 | 0603573N | Advanced Surface Machinery Sys | Volume 2 - 287 |
| 46 | 04 | 0603576N | (U)CHALK EAGLE | Volume 2 - 295 |
| 47 | 04 | 0603581N | (U)LITTORAL COMBAT SHIP | Volume 2 - 299 |
| 48 | 04 | 0603582N | Combat System Integration | Volume 2 - 347 |
| 49 | 04 | 0603595N | (U)Ohio Replacement | Volume 2 - 365 |
| 50 | 04 | 0603596N | (U)LCS Mission Modules | Volume 2 - 381 |
| 51 | 04 | 0603597N | (U)Automated Test and Re-Test (ATRT) | Volume 2 - 407 |

***Budget Activity 04: Advanced Component Development & Prototypes (ACD&P)***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 52 | 04 | 0603609N | Conventional Munitions | Volume 2 - 411 |
| 53 | 04 | 0603611M | Marine Corps Assault Vehicles | Volume 2 - 417 |
| 54 | 04 | 0603635M | Marine Corps Grnd Cmbt/Supt Sys | Volume 2 - 423 |
| 55 | 04 | 0603654N | JT Service Explosive Ordn Dev | Volume 2 - 433 |
| 56 | 04 | 0603658N | Cooperative Engagement | Volume 2 - 449 |
| 57 | 04 | 0603713N | Ocean Engineering Tech Dev | Volume 2 - 465 |
| 58 | 04 | 0603721N | Environmental Protection | Volume 2 - 475 |
| 59 | 04 | 0603724N | Navy Energy Program | Volume 2 - 493 |
| 60 | 04 | 0603725N | Facilities Improvement | Volume 2 - 513 |
| 61 | 04 | 0603734N | (U)CHALK CORAL | Volume 2 - 527 |
| 62 | 04 | 0603739N | Navy Logistic Productivity | Volume 2 - 529 |
| 63 | 04 | 0603746N | (U)RETRACT MAPLE | Volume 2 - 543 |
| 64 | 04 | 0603748N | (U)LINK PLUMERIA | Volume 2 - 545 |
| 65 | 04 | 0603751N | (U)RETRACT ELM | Volume 2 - 547 |
| 66 | 04 | 0603764N | (U)LINK EVERGREEN | Volume 2 - 549 |
| 67 | 04 | 0603787N | (U)SPECIAL PROCESSES | Volume 2 - 551 |
| 68 | 04 | 0603790N | NATO Research and Deve | Volume 2 - 555 |
| 69 | 04 | 0603795N | Land Attack Tech | Volume 2 - 559 |

***Budget Activity 04: Advanced Component Development & Prototypes (ACD&P)***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 70 | 04 | 0603851M | Joint Non-Lethal Weapons Testing | Volume 2 - 563 |
| 71 | 04 | 0603860N | JT Precision Approach & Ldg Sys | Volume 2 - 571 |
| 72 | 04 | 0603889N | Counterdrug RDT&E Projects | Volume 2 - 591 |
| 73 | 04 | 0603925N | Directed Energy and Electric Weapon System | Volume 2 - 595 |
| 74 | 04 | 0604112N | Gerald R Ford Class Nuc Aircraft Carrier CVN 78-80 | Volume 2 - 601 |
| 75 | 04 | 0604122N | Remote Minehunting System (RMS) | Volume 2 - 615 |
| 76 | 04 | 0604272N | Tact Air Dir Infrared CM (TADIRCM) | Volume 2 - 625 |
| 77 | 04 | 0604279N | (U)ASE Self Protection Optimization | Volume 2 - 635 |
| 78 | 04 | 0604454N | LX (R) | Volume 2 - 643 |
| 79 | 04 | 0604653N | JT Cntr Radio Controlled IED Elec War (JCREW) | Volume 2 - 649 |
| 80 | 04 | 0604659N | (U)Precision Strike Weapons Development Program | Volume 2 - 653 |
| 81 | 04 | 0604707N | SEW Architecture/Eng Support | Volume 2 - 657 |
| 82 | 04 | 0604786N | (U)Offensive Anti-Surface Warfare Weapon Dev | Volume 2 - 679 |
| 83 | 04 | 0605812M | (U)Joint Light Tactical Vehicle(JLTV) EMD | Volume 2 - 689 |
| 84 | 04 | 0303354N | ASW Systems Development - MIP | Volume 2 - 699 |
| 85 | 04 | 0304270N | Electronic Warfare Development - MIP | Volume 2 - 705 |

***Budget Activity 05: System Development & Demonstration (SDD)***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 86 | 05 | 0603208N | Training System Aircraft | Volume 3 - 1 |
| 87 | 05 | 0604212N | Other Helicopter Development | Volume 3 - 9 |
| 88 | 05 | 0604214N | AV-8B Aircraft - Engine Dev | Volume 3 - 33 |
| 89 | 05 | 0604215N | Standards Development | Volume 3 - 41 |
| 90 | 05 | 0604216N | Multi-Mssn Helicopter Upgrade Dev | Volume 3 - 77 |
| 91 | 05 | 0604218N | Air/Ocean Equipment Engineering | Volume 3 - 87 |
| 92 | 05 | 0604221N | P-3 Modernization Program | Volume 3 - 97 |
| 93 | 05 | 0604230N | Warfare Support System | Volume 3 - 105 |
| 94 | 05 | 0604231N | Tactical Command System | Volume 3 - 119 |
| 95 | 05 | 0604234N | Advanced Hawkeye | Volume 3 - 161 |
| 96 | 05 | 0604245N | H-1 Upgrades | Volume 3 - 191 |
| 97 | 05 | 0604261N | Acoustic Search Sensors | Volume 3 - 203 |
| 98 | 05 | 0604262N | V-22A | Volume 3 - 213 |
| 99 | 05 | 0604264N | Air Crew Systems Development | Volume 3 - 223 |
| 100 | 05 | 0604269N | EA-18 Squadrons | Volume 3 - 233 |
| 101 | 05 | 0604270N | Electronic Warfare (EW) Dev | Volume 3 - 247 |

***Budget Activity 05: System Development & Demonstration (SDD)***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 102 | 05 | 0604273N | (U)Executive Helo Development | Volume 3 - 275 |
| 103 | 05 | 0604274N | Next Generation Jammer (NGJ) | Volume 3 - 281 |
| 104 | 05 | 0604280N | JT Tact Radio Sys (JTRS) | Volume 3 - 297 |
| 105 | 05 | 0604307N | Surface Combatant Cmbt Sys Eng | Volume 3 - 315 |
| 106 | 05 | 0604311N | LPD-17 Class Systems Integration | Volume 3 - 337 |
| 107 | 05 | 0604329N | Small Diameter Bomb (SDB) | Volume 3 - 343 |
| 108 | 05 | 0604366N | Standard Missile Improvements | Volume 3 - 365 |
| 109 | 05 | 0604373N | Airborne Mine Countermeasures (AMCM) | Volume 3 - 385 |
| 110 | 05 | 0604376M | (U)Marine Air Grnd Task Force(MAGTF)EW for Aviatio | Volume 3 - 415 |
| 111 | 05 | 0604378N | Nav Integrated Fire Control-Counter Air Sys Eng | Volume 3 - 425 |
| 112 | 05 | 0604404N | (U)Unman Carrier Launch A/B Surv & Strk(UCLASS)Sys | Volume 3 - 431 |
| 113 | 05 | 0604501N | Advanced Above Water Sensors | Volume 3 - 447 |
| 114 | 05 | 0604503N | SSN-688 & Trident Modernization | Volume 3 - 473 |
| 115 | 05 | 0604504N | Air Control | Volume 3 - 499 |
| 116 | 05 | 0604512N | Shipboard Aviation Systems | Volume 3 - 515 |
| 117 | 05 | 0604518N | Combat Information Center Conv | Volume 3 - 527 |
| 118 | 05 | 0604522N | (U)Advanced Missile Defense Radar (AMDR) System | Volume 3 - 533 |
| 119 | 05 | 0604558N | New Design SSN | Volume 3 - 543 |

***Budget Activity 05: System Development & Demonstration (SDD)***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 120 | 05 | 0604562N | Submarine Tactical Warfare System | Volume 3 - 577 |
| 121 | 05 | 0604567N | Ship Contract Design/ Live Fire T&E | Volume 3 - 585 |
| 122 | 05 | 0604574N | Navy Tactical Computer Resources | Volume 3 - 635 |
| 123 | 05 | 0604580N | (U)Virginia Payload Module (VPM | Volume 3 - 647 |
| 124 | 05 | 0604601N | Mine Development | Volume 3 - 655 |
| 125 | 05 | 0604610N | Lightweight Torpedo Development | Volume 3 - 661 |
| 126 | 05 | 0604654N | JT Service EOD | Volume 3 - 667 |
| 127 | 05 | 0604703N | Personnel, Trng, Sim, & Human Factors | Volume 3 - 671 |
| 128 | 05 | 0604727N | Joint Standoff Weapon Systems | Volume 3 - 677 |
| 129 | 05 | 0604755N | Ship Self Def (Detect & Cntrl) | Volume 3 - 685 |
| 130 | 05 | 0604756N | Ship Self Def (Engage: Hard Kill) | Volume 3 - 705 |
| 131 | 05 | 0604757N | Ship Self Def (Engage: Soft Kill/EW) | Volume 3 - 721 |
| 132 | 05 | 0604761N | Intelligence Engineering | Volume 3 - 747 |
| 133 | 05 | 0604771N | Medical Development | Volume 3 - 749 |
| 134 | 05 | 0604777N | Navigation/Id System | Volume 3 - 765 |
| 135 | 05 | 0604800M | (U)Joint Strike Fighter (JSF) - EMD | Volume 3 - 787 |
| 136 | 05 | 0604800N | JT Strike Fighter (JSF) - EMD | Volume 3 - 827 |
| 137 | 05 | 0605013M | Marine Corps IT Dev/Mod | Volume 3 - 873 |

***Budget Activity 05: System Development & Demonstration (SDD)***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 138 | 05 | 0605013N | Information Technology Development | Volume 3 - 887 |
| 139 | 05 | 0605212N | CH-53K | Volume 3 - 941 |
| 140 | 05 | 0605220N | Ship to Shore Connector (SSC) | Volume 3 - 953 |
| 141 | 05 | 0605450N | Joint Air-to-ground Missile (JAGM) | Volume 3 - 969 |
| 142 | 05 | 0605500N | Multi-mssn Maritime Aircraft (MMA) (P-8A) | Volume 3 - 973 |
| 143 | 05 | 0204202N | DDG-1000 | Volume 3 - 1005 |
| 144 | 05 | 0304231N | Tactical Command System - MIP | Volume 3 - 1021 |
| 145 | 05 | 0304785N | Tactical Cryptologic Systems | Volume 3 - 1027 |
| 146 | 05 | 0305124N | Special Applications Program | Volume 3 - 1039 |


***Budget Activity 06: RDT&E Management Support***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 147 | 06 | 0604256N | Threat Simulator Development | Volume 4 - 1 |
| 148 | 06 | 0604258N | Target Systems Development | Volume 4 - 13 |
| 149 | 06 | 0604759N | Major T&E Investment | Volume 4 - 27 |

***Budget Activity 06: RDT&E Management Support***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 150 | 06 | 0605126N | (U)Joint Theater Air and Missile Defense Org | Volume 4 - 33 |
| 151 | 06 | 0605152N | Studies & Analysis Supt - Navy | Volume 4 - 37 |
| 152 | 06 | 0605154N | Center For Naval Analyses | Volume 4 - 57 |
| 153 | 06 | 0605502N | Small Business Innovative Research | Volume 4 - 65 |
| 154 | 06 | 0605804N | Technical Information Services | Volume 4 - 109 |
| 155 | 06 | 0605853N | Management, Technical & Intl Supt | Volume 4 - 115 |
| 156 | 06 | 0605856N | Strategic Technical Support | Volume 4 - 167 |
| 157 | 06 | 0605861N | RDT&E Science & Tech Mgmt | Volume 4 - 173 |
| 158 | 06 | 0605863N | RDT&E Ship & Aircraft Support | Volume 4 - 183 |
| 159 | 06 | 0605864N | Test & Evaluation Support | Volume 4 - 195 |
| 160 | 06 | 0605865N | Operational Test & Eval Capability | Volume 4 - 221 |
| 161 | 06 | 0605866N | Navy Space & Electr Warfare Supt | Volume 4 - 229 |
| 162 | 06 | 0605867N | Space & Elec War Surv/Recon | Volume 4 - 237 |
| 163 | 06 | 0605873M | Marine Corps Program Wide Supt | Volume 4 - 243 |
| 164 | 06 | 0305885N | Tactical Cryptologic Activities | Volume 4 - 261 |
| 165 | 06 | 0909999N | Cancelled Account Adjustments | Volume 4 - 265 |

***Budget Activity 07: Operational Systems Development***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 167 | 07 | 0604227N | Harpoon Modifications | Volume 5 - 1 |
| 168 | 07 | 0604402N | Unmanned Combat Air Veh(UCAV) Adv Cp/Proto Dev | Volume 5 - 5 |
| 169 | 07 | 0604766M | (U)MARINE CORPS DATA SYSTEMS | Volume 5 - 15 |
| 170 | 07 | 0605525N | (U)CARRIER ONBOARD DELIVERY (COD) FOLLOW ON | Volume 5 - 19 |
| 171 | 07 | 0605555N | (U)STRIKE WEAPONS DEVELOPMENT | Volume 5 - 23 |
| 172 | 07 | 0101221N | Strategic Sub & Wpns Sys Supt | Volume 5 - 33 |
| 173 | 07 | 0101224N | SSBN Security Tech Program | Volume 5 - 57 |
| 174 | 07 | 0101226N | Submarine Acoustic War Dev | Volume 5 - 59 |
| 175 | 07 | 0101402N | Navy Strategic Comms | Volume 5 - 65 |
| 176 | 07 | 0203761N | Rapid Technology Transition (RTT) | Volume 5 - 79 |
| 177 | 07 | 0204136N | F/A-18 Squadrons | Volume 5 - 89 |
| 178 | 07 | 0204152N | E-2 Squadrons | Volume 5 - 115 |
| 179 | 07 | 0204163N | Fleet Tactical Development | Volume 5 - 121 |
| 180 | 07 | 0204228N | Surface Support | Volume 5 - 131 |
| 181 | 07 | 0204229N | Tomahawk Mssn Planning Ctr | Volume 5 - 137 |
| 182 | 07 | 0204311N | Integrated Surveillance System | Volume 5 - 147 |

***Budget Activity 07: Operational Systems Development***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 183 | 07 | 0204413N | Amphibious Tactical Supt Units | Volume 5 - 157 |
| 184 | 07 | 0204460M | (U)Ground/Air Task Oriented Radar (G/ATOR) | Volume 5 - 165 |
| 185 | 07 | 0204571N | Consolidated Trng Sys Dev | Volume 5 - 173 |
| 186 | 07 | 0204574N | Cryptologic Direct Support | Volume 5 - 201 |
| 187 | 07 | 0204575N | Elect Warfare Readiness Supt | Volume 5 - 205 |
| 188 | 07 | 0205601N | Harm Improvement | Volume 5 - 213 |
| 189 | 07 | 0205604N | Tactical Data Links | Volume 5 - 235 |
| 190 | 07 | 0205620N | Surface ASW Cmbt Sys Integr | Volume 5 - 275 |
| 191 | 07 | 0205632N | MK-48 ADCAP | Volume 5 - 283 |
| 192 | 07 | 0205633N | Aviation Improvements | Volume 5 - 289 |
| 193 | 07 | 0205658N | Navy Science Assistance Progr | Volume 5 - 321 |
| 194 | 07 | 0205675N | Operational Nuclear Power Sys | Volume 5 - 329 |
| 195 | 07 | 0206313M | Marine Corps Comms Systems | Volume 5 - 331 |
| 196 | 07 | 0206335M | Common Aviation Command and Control System (CAC2S) | Volume 5 - 437 |
| 197 | 07 | 0206623M | MC Ground Cmbt Spt Arms Sys | Volume 5 - 447 |
| 198 | 07 | 0206624M | Marine Corps Cmbt Services Supt | Volume 5 - 523 |
| 199 | 07 | 0206625M | USMC Intelligence/Electronics Warfare Sys | Volume 5 - 573 |
| 200 | 07 | 0207161N | Tactical Aim Missiles | Volume 5 - 601 |

***Budget Activity 07: Operational Systems Development***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 201 | 07 | 0207163N | AMRAAM | Volume 5 - 619 |
| 202 | 07 | 0208058N | Joint High Speed Vessel (JHSV) | Volume 5 - 629 |
| 206 | 07 | 0303109N | Satellite Communications (Space) | Volume 5 - 633 |
| 207 | 07 | 0303138N | Consolidated Afloat Network Ent Services(CANES) | Volume 5 - 657 |
| 208 | 07 | 0303140N | Information Sys Security Program | Volume 5 - 673 |
| 209 | 07 | 0303150M | WWMCCS/GLOBAL COMMAND AND CONTROL SYSTEM | Volume 5 - 693 |
| 211 | 07 | 0305149N | Cobra Judy | Volume 5 - 697 |
| 212 | 07 | 0305160N | Navy Meteorological and Ocean Sensors-Space(METOC) | Volume 5 - 701 |
| 213 | 07 | 0305192N | JT Military Intel Programs | Volume 5 - 707 |
| 214 | 07 | 0305204N | Tactical Unmanned Aer Vehicles | Volume 5 - 709 |
| 215 | 07 | 0305207N | Manned Reconnaissance Sys | Volume 5 - 717 |
| 216 | 07 | 0305208M | (U)Distributed Common Ground/Surface Systems | Volume 5 - 721 |
| 217 | 07 | 0305208N | Distributed Common Ground Sys | Volume 5 - 729 |
| 218 | 07 | 0305220N | RQ-4 UAV | Volume 5 - 745 |
| 219 | 07 | 0305231N | MQ-8 UAV | Volume 5 - 757 |
| 220 | 07 | 0305232M | RQ-11 UAV | Volume 5 - 769 |
| 221 | 07 | 0305233N | RQ-7 UAV | Volume 5 - 773 |
| 222 | 07 | 0305234N | (U)SMALL (LEVEL 0) TACTICAL UAS (STUASL0) | Volume 5 - 777 |

***Budget Activity 07: Operational Systems Development***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 223 | 07 | 0305239M | (U)RQ-21A | Volume 5 - 783 |
| 224 | 07 | 0305241N | (U) MULTI-INTELLIGENCE SENSOR DEVELOPMENT | Volume 5 - 789 |
| 225 | 07 | 0305242M | Unmanned Aerial Systems (UAS) Payloads | Volume 5 - 791 |
| 226 | 07 | 0308601N | Modeling & Simulation Support | Volume 5 - 795 |
| 227 | 07 | 0702207N | Depot Maintenance (NON-IF) | Volume 5 - 805 |
| 228 | 07 | 0708011N | Industrial Preparedness | Volume 5 - 813 |
| 229 | 07 | 0708730N | Maritime Tech (MARITECH) | Volume 5 - 825 |

THIS PAGE INTENTIONALLY LEFT BLANK

## Master Program Element Table of Contents (Alphabetically by Program Element Title)


| Program Element Title | Program Element Number | Line Item | Budget Activity | Page |
|---|---|---|---|---|
| (U) MULTI-INTELLIGENCE SENSOR DEVELOPMENT | 0305241N | 224 | 07 | Volume 5 - 789 |
| (U)AIRCRAFT SYSTEMS | 0603251N | 28 | 04 | Volume 2 - 59 |
| (U)ASE Self Protection Optimization | 0604279N | 77 | 04 | Volume 2 - 635 |
| (U)Advanced Missile Defense Radar (AMDR) System | 0604522N | 118 | 05 | Volume 3 - 533 |
| (U)Automated Test and Re-Test (ATRT) | 0603597N | 51 | 04 | Volume 2 - 407 |
| (U)CARRIER ONBOARD DELIVERY (COD) FOLLOW ON | 0605525N | 170 | 07 | Volume 5 - 19 |
| (U)CHALK CORAL | 0603734N | 61 | 04 | Volume 2 - 527 |
| (U)CHALK EAGLE | 0603576N | 46 | 04 | Volume 2 - 295 |
| (U)Distributed Common Ground/Surface Systems | 0305208M | 216 | 07 | Volume 5 - 721 |
| (U)Executive Helo Development | 0604273N | 102 | 05 | Volume 3 - 275 |
| (U)Future Naval Capabilities Advanced Tech Dev | 0603673N | 20 | 03 | Volume 1 - 367 |
| (U)Future Naval Capabilities Applied Research | 0602750N | 13 | 02 | Volume 1 - 249 |
| (U)Ground/Air Task Oriented Radar (G/ATOR) | 0204460M | 184 | 07 | Volume 5 - 165 |
| (U)Joint Light Tactical Vehicle(JLTV) EMD | 0605812M | 83 | 04 | Volume 2 - 689 |
| (U)Joint Strike Fighter (JSF) - EMD | 0604800M | 135 | 05 | Volume 3 - 787 |
| (U)Joint Theater Air and Missile Defense Org | 0605126N | 150 | 06 | Volume 4 - 33 |
| (U)LCS Mission Modules | 0603596N | 50 | 04 | Volume 2 - 381 |

| Program Element Title | Program Element Number | Line Item | Budget Activity | Page |
|---|---|---|---|---|
| (U)LINK EVERGREEN | 0603764N | 66 | 04 | Volume 2 - 549 |
| (U)LINK PLUMERIA | 0603748N | 64 | 04 | Volume 2 - 545 |
| (U)LITTORAL COMBAT SHIP | 0603581N | 47 | 04 | Volume 2 - 299 |
| (U)MARINE CORPS DATA SYSTEMS | 0604766M | 169 | 07 | Volume 5 - 15 |
| (U)Marine Air Grnd Task Force(MAGTF)EW for Aviatio | 0604376M | 110 | 05 | Volume 3 - 415 |
| (U)Offensive Anti-Surface Warfare Weapon Dev | 0604786N | 82 | 04 | Volume 2 - 679 |
| (U)Ohio Replacement | 0603595N | 49 | 04 | Volume 2 - 365 |
| (U)PILOT FISH | 0603525N | 35 | 04 | Volume 2 - 161 |
| (U)Precision Strike Weapons Development Program | 0604659N | 80 | 04 | Volume 2 - 653 |
| (U)RETRACT ELM | 0603751N | 65 | 04 | Volume 2 - 547 |
| (U)RETRACT JUNIPER | 0603536N | 37 | 04 | Volume 2 - 165 |
| (U)RETRACT LARCH | 0603527N | 36 | 04 | Volume 2 - 163 |
| (U)RETRACT MAPLE | 0603746N | 63 | 04 | Volume 2 - 543 |
| (U)RQ-21A | 0305239M | 223 | 07 | Volume 5 - 783 |
| (U)SMALL (LEVEL 0) TACTICAL UAS (STUASL0) | 0305234N | 222 | 07 | Volume 5 - 777 |
| (U)SPECIAL PROCESSES | 0603787N | 67 | 04 | Volume 2 - 551 |
| (U)STRIKE WEAPONS DEVELOPMENT | 0605555N | 171 | 07 | Volume 5 - 23 |
| (U)Unman Carrier Launch A/B Surv & Strk(UCLASS)Sys | 0604404N | 112 | 05 | Volume 3 - 431 |
| (U)Virginia Payload Module (VPM | 0604580N | 123 | 05 | Volume 3 - 647 |

| Program Element Title | Program Element Number | Line Item | Budget Activity | Page |
|---|---|---|---|---|
| AMRAAM | 0207163N | 201 | 07 | Volume 5 - 619 |
| ASW Systems Development | 0603254N | 29 | 04 | Volume 2 - 69 |
| ASW Systems Development - MIP | 0303354N | 84 | 04 | Volume 2 - 699 |
| AV-8B Aircraft - Engine Dev | 0604214N | 88 | 05 | Volume 3 - 33 |
| Acoustic Search Sensors | 0604261N | 97 | 05 | Volume 3 - 203 |
| Advanced Above Water Sensors | 0604501N | 113 | 05 | Volume 3 - 447 |
| Advanced Combat Systems Tech | 0603382N | 31 | 04 | Volume 2 - 83 |
| Advanced Hawkeye | 0604234N | 95 | 05 | Volume 3 - 161 |
| Advanced Nuclear Power Systems | 0603570N | 44 | 04 | Volume 2 - 279 |
| Advanced Submarine System Development | 0603561N | 40 | 04 | Volume 2 - 201 |
| Advanced Surface Machinery Sys | 0603573N | 45 | 04 | Volume 2 - 287 |
| Air Control | 0604504N | 115 | 05 | Volume 3 - 499 |
| Air Crew Systems Development | 0604264N | 99 | 05 | Volume 3 - 223 |
| Air/Ocean Equipment Engineering | 0604218N | 91 | 05 | Volume 3 - 87 |
| Air/Ocean Tactical Applications | 0603207N | 25 | 04 | Volume 2 - 1 |
| Airborne Mine Countermeasures (AMCM) | 0604373N | 109 | 05 | Volume 3 - 385 |
| Amphibious Tactical Supt Units | 0204413N | 183 | 07 | Volume 5 - 157 |
| Aviation Improvements | 0205633N | 192 | 07 | Volume 5 - 289 |
| Aviation Survivability | 0603216N | 26 | 04 | Volume 2 - 37 |

| Program Element Title | Program Element Number | Line Item | Budget Activity | Page |
|---|---|---|---|---|
| CH-53K | 0605212N | 139 | 05 | Volume 3 - 941 |
| Cancelled Account Adjustments | 0909999N | 165 | 06 | Volume 4 - 265 |
| Carrier Systems Development | 0603512N | 34 | 04 | Volume 2 - 141 |
| Center For Naval Analyses | 0605154N | 152 | 06 | Volume 4 - 57 |
| Cobra Judy | 0305149N | 211 | 07 | Volume 5 - 697 |
| Combat Information Center Conv | 0604518N | 117 | 05 | Volume 3 - 527 |
| Combat System Integration | 0603582N | 48 | 04 | Volume 2 - 347 |
| Common Aviation Command and Control System (CAC2S) | 0206335M | 196 | 07 | Volume 5 - 437 |
| Common Picture Applied Research | 0602235N | 7 | 02 | Volume 1 - 143 |
| Consolidated Afloat Network Ent Services(CANES) | 0303138N | 207 | 07 | Volume 5 - 657 |
| Consolidated Trng Sys Dev | 0204571N | 185 | 07 | Volume 5 - 173 |
| Conventional Munitions | 0603609N | 52 | 04 | Volume 2 - 411 |
| Cooperative Engagement | 0603658N | 56 | 04 | Volume 2 - 449 |
| Counterdrug RDT&E Projects | 0603889N | 72 | 04 | Volume 2 - 591 |
| Cryptologic Direct Support | 0204574N | 186 | 07 | Volume 5 - 201 |
| DDG-1000 | 0204202N | 143 | 05 | Volume 3 - 1005 |
| Defense Research Sciences | 0601153N | 3 | 01 | Volume 1 - 25 |
| Deployable JT Cmd & Control | 0603237N | 27 | 04 | Volume 2 - 53 |
| Depot Maintenance (NON-IF) | 0702207N | 227 | 07 | Volume 5 - 805 |

| Program Element Title | Program Element Number | Line Item | Budget Activity | Page |
|---|---|---|---|---|
| Directed Energy and Electric Weapon System | 0603925N | 73 | 04 | Volume 2 - 595 |
| Distributed Common Ground Sys | 0305208N | 217 | 07 | Volume 5 - 729 |
| E-2 Squadrons | 0204152N | 178 | 07 | Volume 5 - 115 |
| EA-18 Squadrons | 0604269N | 100 | 05 | Volume 3 - 233 |
| Elect Warfare Readiness Supt | 0204575N | 187 | 07 | Volume 5 - 205 |
| Electromagnetic Systems Advanced Technology | 0603271N | 17 | 03 | Volume 1 - 311 |
| Electromagnetic Systems Applied Research | 0602271N | 9 | 02 | Volume 1 - 187 |
| Electronic Warfare (EW) Dev | 0604270N | 101 | 05 | Volume 3 - 247 |
| Electronic Warfare Development - MIP | 0304270N | 85 | 04 | Volume 2 - 705 |
| Environmental Protection | 0603721N | 58 | 04 | Volume 2 - 475 |
| F/A-18 Squadrons | 0204136N | 177 | 07 | Volume 5 - 89 |
| Facilities Improvement | 0603725N | 60 | 04 | Volume 2 - 513 |
| Fleet Tactical Development | 0204163N | 179 | 07 | Volume 5 - 121 |
| Force Protection Advanced Technology | 0603123N | 16 | 03 | Volume 1 - 303 |
| Force Protection Applied Res | 0602123N | 5 | 02 | Volume 1 - 89 |
| Gerald R Ford Class Nuc Aircraft Carrier CVN 78-80 | 0604112N | 74 | 04 | Volume 2 - 601 |
| H-1 Upgrades | 0604245N | 96 | 05 | Volume 3 - 191 |
| Harm Improvement | 0205601N | 188 | 07 | Volume 5 - 213 |
| Harpoon Modifications | 0604227N | 167 | 07 | Volume 5 - 1 |

| Program Element Title | Program Element Number | Line Item | Budget Activity | Page |
|---|---|---|---|---|
| In-House Lab Independent Res | 0601152N | 2 | 01 | Volume 1 - 7 |
| Industrial Preparedness | 0708011N | 228 | 07 | Volume 5 - 813 |
| Information Sys Security Program | 0303140N | 208 | 07 | Volume 5 - 673 |
| Information Technology Development | 0605013N | 138 | 05 | Volume 3 - 887 |
| Integrated Surveillance System | 0204311N | 182 | 07 | Volume 5 - 147 |
| Intelligence Engineering | 0604761N | 132 | 05 | Volume 3 - 747 |
| JT Cntr Radio Controlled IED Elec War (JCREW) | 0604653N | 79 | 04 | Volume 2 - 649 |
| JT Military Intel Programs | 0305192N | 213 | 07 | Volume 5 - 707 |
| JT Non-Lethal Wpns Applied Res | 0602651M | 11 | 02 | Volume 1 - 233 |
| JT Non-Lethal Wpns Tech Dev | 0603651M | 19 | 03 | Volume 1 - 361 |
| JT Precision Approach & Ldg Sys | 0603860N | 71 | 04 | Volume 2 - 571 |
| JT Service EOD | 0604654N | 126 | 05 | Volume 3 - 667 |
| JT Service Explosive Ordn Dev | 0603654N | 55 | 04 | Volume 2 - 433 |
| JT Strike Fighter (JSF) - EMD | 0604800N | 136 | 05 | Volume 3 - 827 |
| JT Tact Radio Sys (JTRS) | 0604280N | 104 | 05 | Volume 3 - 297 |
| Joint Air-to-ground Missile (JAGM) | 0605450N | 141 | 05 | Volume 3 - 969 |
| Joint High Speed Vessel (JHSV) | 0208058N | 202 | 07 | Volume 5 - 629 |
| Joint Non-Lethal Weapons Testing | 0603851M | 70 | 04 | Volume 2 - 563 |
| Joint Standoff Weapon Systems | 0604727N | 128 | 05 | Volume 3 - 677 |

| Program Element Title | Program Element Number | Line Item | Budget Activity | Page |
|---|---|---|---|---|
| LPD-17 Class Systems Integration | 0604311N | 106 | 05 | Volume 3 - 337 |
| LX (R) | 0604454N | 78 | 04 | Volume 2 - 643 |
| Land Attack Tech | 0603795N | 69 | 04 | Volume 2 - 559 |
| Lightweight Torpedo Development | 0604610N | 125 | 05 | Volume 3 - 661 |
| MC Advanced Technology Demo | 0603640M | 18 | 03 | Volume 1 - 323 |
| MC Ground Cmbt Spt Arms Sys | 0206623M | 197 | 07 | Volume 5 - 447 |
| MK-48 ADCAP | 0205632N | 191 | 07 | Volume 5 - 283 |
| MQ-8 UAV | 0305231N | 219 | 07 | Volume 5 - 757 |
| Major T&E Investment | 0604759N | 149 | 06 | Volume 4 - 27 |
| Management, Technical & Intl Supt | 0605853N | 155 | 06 | Volume 4 - 115 |
| Manned Reconnaissance Sys | 0305207N | 215 | 07 | Volume 5 - 717 |
| Marine Corps Assault Vehicles | 0603611M | 53 | 04 | Volume 2 - 417 |
| Marine Corps Cmbt Services Supt | 0206624M | 198 | 07 | Volume 5 - 523 |
| Marine Corps Comms Systems | 0206313M | 195 | 07 | Volume 5 - 331 |
| Marine Corps Grnd Cmbt/Supt Sys | 0603635M | 54 | 04 | Volume 2 - 423 |
| Marine Corps IT Dev/Mod | 0605013M | 137 | 05 | Volume 3 - 873 |
| Marine Corps Lndg Force Tech | 0602131M | 6 | 02 | Volume 1 - 111 |
| Marine Corps Program Wide Supt | 0605873M | 163 | 06 | Volume 4 - 243 |
| Maritime Tech (MARITECH) | 0708730N | 229 | 07 | Volume 5 - 825 |

| Program Element Title | Program Element Number | Line Item | Budget Activity | Page |
|---|---|---|---|---|
| Medical Development | 0604771N | 133 | 05 | Volume 3 - 749 |
| Mine & Exp Warfare Applied Res | 0602782N | 14 | 02 | Volume 1 - 289 |
| Mine Development | 0604601N | 124 | 05 | Volume 3 - 655 |
| Mine and Expeditionary Warfare Advanced Technology | 0603782N | 24 | 03 | Volume 1 - 431 |
| Modeling & Simulation Support | 0308601N | 226 | 07 | Volume 5 - 795 |
| Multi-Mssn Helicopter Upgrade Dev | 0604216N | 90 | 05 | Volume 3 - 77 |
| Multi-mssn Maritime Aircraft (MMA) (P-8A) | 0605500N | 142 | 05 | Volume 3 - 973 |
| NATO Research and Deve | 0603790N | 68 | 04 | Volume 2 - 555 |
| Nav Integrated Fire Control-Counter Air Sys Eng | 0604378N | 111 | 05 | Volume 3 - 425 |
| Navigation/Id System | 0604777N | 134 | 05 | Volume 3 - 765 |
| Navy Energy Program | 0603724N | 59 | 04 | Volume 2 - 493 |
| Navy Logistic Productivity | 0603739N | 62 | 04 | Volume 2 - 529 |
| Navy Meteorological and Ocean Sensors-Space(METOC) | 0305160N | 212 | 07 | Volume 5 - 701 |
| Navy Science Assistance Progr | 0205658N | 193 | 07 | Volume 5 - 321 |
| Navy Space & Electr Warfare Supt | 0605866N | 161 | 06 | Volume 4 - 229 |
| Navy Strategic Comms | 0101402N | 175 | 07 | Volume 5 - 65 |
| Navy Tactical Computer Resources | 0604574N | 122 | 05 | Volume 3 - 635 |
| Navy Warfighting Exp & Demo | 0603758N | 23 | 03 | Volume 1 - 425 |
| New Design SSN | 0604558N | 119 | 05 | Volume 3 - 543 |

| Program Element Title | Program Element Number | Line Item | Budget Activity | Page |
|---|---|---|---|---|
| Next Generation Jammer (NGJ) | 0604274N | 103 | 05 | Volume 3 - 281 |
| Ocean Engineering Tech Dev | 0603713N | 57 | 04 | Volume 2 - 465 |
| Ocean Wrfghtg Env Applied Res | 0602435N | 10 | 02 | Volume 1 - 217 |
| Operational Nuclear Power Sys | 0205675N | 194 | 07 | Volume 5 - 329 |
| Operational Test & Eval Capability | 0605865N | 160 | 06 | Volume 4 - 221 |
| Other Helicopter Development | 0604212N | 87 | 05 | Volume 3 - 9 |
| P-3 Modernization Program | 0604221N | 92 | 05 | Volume 3 - 97 |
| Personnel, Trng, Sim, & Human Factors | 0604703N | 127 | 05 | Volume 3 - 671 |
| Power Proj Applied Research | 0602114N | 4 | 02 | Volume 1 - 75 |
| Power Projection Advanced Technology | 0603114N | 15 | 03 | Volume 1 - 297 |
| RDT&E Science & Tech Mgmt | 0605861N | 157 | 06 | Volume 4 - 173 |
| RDT&E Ship & Aircraft Support | 0605863N | 158 | 06 | Volume 4 - 183 |
| RQ-11 UAV | 0305232M | 220 | 07 | Volume 5 - 769 |
| RQ-4 UAV | 0305220N | 218 | 07 | Volume 5 - 745 |
| RQ-7 UAV | 0305233N | 221 | 07 | Volume 5 - 773 |
| Radiological Control | 0603542N | 38 | 04 | Volume 2 - 167 |
| Rapid Technology Transition (RTT) | 0203761N | 176 | 07 | Volume 5 - 79 |
| Remote Minehunting System (RMS) | 0604122N | 75 | 04 | Volume 2 - 615 |
| SEW Architecture/Eng Support | 0604707N | 81 | 04 | Volume 2 - 657 |

| Program Element Title | Program Element Number | Line Item | Budget Activity | Page |
|---|---|---|---|---|
| SSBN Security Tech Program | 0101224N | 173 | 07 | Volume 5 - 57 |
| SSN-688 & Trident Modernization | 0604503N | 114 | 05 | Volume 3 - 473 |
| Satellite Communications (Space) | 0303109N | 206 | 07 | Volume 5 - 633 |
| Ship Concept Advanced Design | 0603563N | 42 | 04 | Volume 2 - 235 |
| Ship Contract Design/ Live Fire T&E | 0604567N | 121 | 05 | Volume 3 - 585 |
| Ship Prel Design & Feasibility Studies | 0603564N | 43 | 04 | Volume 2 - 251 |
| Ship Self Def (Detect & Cntrl) | 0604755N | 129 | 05 | Volume 3 - 685 |
| Ship Self Def (Engage: Hard Kill) | 0604756N | 130 | 05 | Volume 3 - 705 |
| Ship Self Def (Engage: Soft Kill/EW) | 0604757N | 131 | 05 | Volume 3 - 721 |
| Ship to Shore Connector (SSC) | 0605220N | 140 | 05 | Volume 3 - 953 |
| Shipboard Aviation Systems | 0604512N | 116 | 05 | Volume 3 - 515 |
| Small Business Innovative Research | 0605502N | 153 | 06 | Volume 4 - 65 |
| Small Diameter Bomb (SDB) | 0604329N | 107 | 05 | Volume 3 - 343 |
| Space & Elec War Surv/Recon | 0605867N | 162 | 06 | Volume 4 - 237 |
| Special Applications Program | 0305124N | 146 | 05 | Volume 3 - 1039 |
| Standard Missile Improvements | 0604366N | 108 | 05 | Volume 3 - 365 |
| Standards Development | 0604215N | 89 | 05 | Volume 3 - 41 |
| Strategic Sub & Wpns Sys Supt | 0101221N | 172 | 07 | Volume 5 - 33 |
| Strategic Technical Support | 0605856N | 156 | 06 | Volume 4 - 167 |

| Program Element Title | Program Element Number | Line Item | Budget Activity | Page |
|---|---|---|---|---|
| Studies & Analysis Supt - Navy | 0605152N | 151 | 06 | Volume 4 - 37 |
| Submarine Acoustic War Dev | 0101226N | 174 | 07 | Volume 5 - 59 |
| Submarine Tactical Warfare Sys | 0603562N | 41 | 04 | Volume 2 - 225 |
| Submarine Tactical Warfare System | 0604562N | 120 | 05 | Volume 3 - 577 |
| Surface & Shallow Water MCM | 0603502N | 32 | 04 | Volume 2 - 91 |
| Surface ASW | 0603553N | 39 | 04 | Volume 2 - 193 |
| Surface ASW Cmbt Sys Integr | 0205620N | 190 | 07 | Volume 5 - 275 |
| Surface Combatant Cmbt Sys Eng | 0604307N | 105 | 05 | Volume 3 - 315 |
| Surface Ship Torpedo Defense | 0603506N | 33 | 04 | Volume 2 - 135 |
| Surface Support | 0204228N | 180 | 07 | Volume 5 - 131 |
| Tact Air Dir Infrared CM (TADIRCM) | 0604272N | 76 | 04 | Volume 2 - 625 |
| Tactical Aim Missiles | 0207161N | 200 | 07 | Volume 5 - 601 |
| Tactical Airborne Reconnaissance | 0603261N | 30 | 04 | Volume 2 - 77 |
| Tactical Command System | 0604231N | 94 | 05 | Volume 3 - 119 |
| Tactical Command System - MIP | 0304231N | 144 | 05 | Volume 3 - 1021 |
| Tactical Cryptologic Activities | 0305885N | 164 | 06 | Volume 4 - 261 |
| Tactical Cryptologic Systems | 0304785N | 145 | 05 | Volume 3 - 1027 |
| Tactical Data Links | 0205604N | 189 | 07 | Volume 5 - 235 |
| Tactical Unmanned Aer Vehicles | 0305204N | 214 | 07 | Volume 5 - 709 |

| Program Element Title | Program Element Number | Line Item | Budget Activity | Page |
|---|---|---|---|---|
| Target Systems Development | 0604258N | 148 | 06 | Volume 4 - 13 |
| Technical Information Services | 0605804N | 154 | 06 | Volume 4 - 109 |
| Test & Evaluation Support | 0605864N | 159 | 06 | Volume 4 - 195 |
| Threat Simulator Development | 0604256N | 147 | 06 | Volume 4 - 1 |
| Tomahawk Mssn Planning Ctr | 0204229N | 181 | 07 | Volume 5 - 137 |
| Training System Aircraft | 0603208N | 86 | 05 | Volume 3 - 1 |
| USMC Intelligence/Electronics Warfare Sys | 0206625M | 199 | 07 | Volume 5 - 573 |
| Undersea Warfare Advanced Tech | 0603747N | 22 | 03 | Volume 1 - 419 |
| Undersea Warfare Applied Res | 0602747N | 12 | 02 | Volume 1 - 239 |
| University Research Initiatives | 0601103N | 1 | 01 | Volume 1 - 1 |
| Unmanned Aerial Systems (UAS) Payloads | 0305242M | 225 | 07 | Volume 5 - 791 |
| Unmanned Combat Air Veh(UCAV) Adv Cp/Proto Dev | 0604402N | 168 | 07 | Volume 5 - 5 |
| V-22A | 0604262N | 98 | 05 | Volume 3 - 213 |
| WWMCCS/GLOBAL COMMAND AND CONTROL SYSTEM | 0303150M | 209 | 07 | Volume 5 - 693 |
| Warfare Support System | 0604230N | 93 | 05 | Volume 3 - 105 |
| Warfighter Protection Adv Tech | 0603729N | 21 | 03 | Volume 1 - 411 |
| Warfighter Sustainment Applied Res | 0602236N | 8 | 02 | Volume 1 - 167 |

## Program Element Table of Contents (by Budget Activity then Line Item Number)

***Budget Activity 01: Basic Research***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 1 | 01 | 0601103N | University Research Initiatives | Volume 1 - 1 |
| 2 | 01 | 0601152N | In-House Lab Independent Res | Volume 1 - 7 |
| 3 | 01 | 0601153N | Defense Research Sciences | Volume 1 - 25 |


***Budget Activity 02: Applied Research***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 4 | 02 | 0602114N | Power Proj Applied Research | Volume 1 - 75 |
| 5 | 02 | 0602123N | Force Protection Applied Res | Volume 1 - 89 |
| 6 | 02 | 0602131M | Marine Corps Lndg Force Tech | Volume 1 - 111 |
| 7 | 02 | 0602235N | Common Picture Applied Research | Volume 1 - 143 |
| 8 | 02 | 0602236N | Warfighter Sustainment Applied Res | Volume 1 - 167 |
| 9 | 02 | 0602271N | Electromagnetic Systems Applied Research | Volume 1 - 187 |

***Budget Activity 02: Applied Research***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 10 | 02 | 0602435N | Ocean Wrfghtg Env Applied Res | Volume 1 - 217 |
| 11 | 02 | 0602651M | JT Non-Lethal Wpns Applied Res | Volume 1 - 233 |
| 12 | 02 | 0602747N | Undersea Warfare Applied Res | Volume 1 - 239 |
| 13 | 02 | 0602750N | (U)Future Naval Capabilities Applied Research | Volume 1 - 249 |
| 14 | 02 | 0602782N | Mine & Exp Warfare Applied Res | Volume 1 - 289 |


***Budget Activity 03: Advanced Technology Development (ATD)***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 15 | 03 | 0603114N | Power Projection Advanced Technology | Volume 1 - 297 |
| 16 | 03 | 0603123N | Force Protection Advanced Technology | Volume 1 - 303 |
| 17 | 03 | 0603271N | Electromagnetic Systems Advanced Technology | Volume 1 - 311 |
| 18 | 03 | 0603640M | MC Advanced Technology Demo | Volume 1 - 323 |
| 19 | 03 | 0603651M | JT Non-Lethal Wpns Tech Dev | Volume 1 - 361 |
| 20 | 03 | 0603673N | (U)Future Naval Capabilities Advanced Tech Dev | Volume 1 - 367 |
| 21 | 03 | 0603729N | Warfighter Protection Adv Tech | Volume 1 - 411 |

***Budget Activity 03: Advanced Technology Development (ATD)***
***Appropriation 1319: Research, Development, Test & Evaluation, Navy***


| Line Item | Budget Activity | Program Element Number | Program Element Title | Page |
|---|---|---|---|---|
| 22 | 03 | 0603747N | Undersea Warfare Advanced Tech | Volume 1 - 419 |
| 23 | 03 | 0603758N | Navy Warfighting Exp & Demo | Volume 1 - 425 |
| 24 | 03 | 0603782N | Mine and Expeditionary Warfare Advanced Technology | Volume 1 - 431 |

THIS PAGE INTENTIONALLY LEFT BLANK

## Program Element Table of Contents (Alphabetically by Program Element Title)


| Program Element Title | Program Element Number | Line Item | Budget Activity | Page |
|---|---|---|---|---|
| (U)Future Naval Capabilities Advanced Tech Dev | 0603673N | 20 | 03 | Volume 1 - 367 |
| (U)Future Naval Capabilities Applied Research | 0602750N | 13 | 02 | Volume 1 - 249 |
| Common Picture Applied Research | 0602235N | 7 | 02 | Volume 1 - 143 |
| Defense Research Sciences | 0601153N | 3 | 01 | Volume 1 - 25 |
| Electromagnetic Systems Advanced Technology | 0603271N | 17 | 03 | Volume 1 - 311 |
| Electromagnetic Systems Applied Research | 0602271N | 9 | 02 | Volume 1 - 187 |
| Force Protection Advanced Technology | 0603123N | 16 | 03 | Volume 1 - 303 |
| Force Protection Applied Res | 0602123N | 5 | 02 | Volume 1 - 89 |
| In-House Lab Independent Res | 0601152N | 2 | 01 | Volume 1 - 7 |
| JT Non-Lethal Wpns Applied Res | 0602651M | 11 | 02 | Volume 1 - 233 |
| JT Non-Lethal Wpns Tech Dev | 0603651M | 19 | 03 | Volume 1 - 361 |
| MC Advanced Technology Demo | 0603640M | 18 | 03 | Volume 1 - 323 |
| Marine Corps Lndg Force Tech | 0602131M | 6 | 02 | Volume 1 - 111 |
| Mine & Exp Warfare Applied Res | 0602782N | 14 | 02 | Volume 1 - 289 |
| Mine and Expeditionary Warfare Advanced Technology | 0603782N | 24 | 03 | Volume 1 - 431 |
| Navy Warfighting Exp & Demo | 0603758N | 23 | 03 | Volume 1 - 425 |
| Ocean Wrfghtg Env Applied Res | 0602435N | 10 | 02 | Volume 1 - 217 |

| Program Element Title | Program Element Number | Line Item | Budget Activity | Page |
|---|---|---|---|---|
| Power Proj Applied Research | 0602114N | 4 | 02 | Volume 1 - 75 |
| Power Projection Advanced Technology | 0603114N | 15 | 03 | Volume 1 - 297 |
| Undersea Warfare Advanced Tech | 0603747N | 22 | 03 | Volume 1 - 419 |
| Undersea Warfare Applied Res | 0602747N | 12 | 02 | Volume 1 - 239 |
| University Research Initiatives | 0601103N | 1 | 01 | Volume 1 - 1 |
| Warfighter Protection Adv Tech | 0603729N | 21 | 03 | Volume 1 - 411 |
| Warfighter Sustainment Applied Res | 0602236N | 8 | 02 | Volume 1 - 167 |

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 1: *Basic Research* | **R-1 Program Element (Number/Name)**<br>PE 0601103N *I University Research Initiatives* |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Program Element | 0.000 | 117.855 | 112.617 | 113.908 | - | 113.908 | 116.196 | 118.764 | 120.901 | 120.901 | Continuing | Continuing |
| 0000: *University Research Initiatives* | 0.000 | 99.521 | 112.617 | 113.908 | - | 113.908 | 116.196 | 118.764 | 120.901 | 120.901 | Continuing | Continuing |
| 9999: *Congressional Adds* | 0.000 | 18.334 | - | - | - | - | - | - | - | - | - | 18.334 |

# The FY 2015 OCO Request will be submitted at a later date.

**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 innovation, 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 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 113.690 | 112.617 | 113.908 | - | 113.908 |
| Current President's Budget | 117.855 | 112.617 | 113.908 | - | 113.908 |
| Total Adjustments | 4.165 | - | - | - | - |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | -0.809 | - | | | |
| • SBIR/STTR Transfer | -3.876 | - | | | |
| • Rate/Misc Adjustments | 0.001 | - | - | - | - |

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | Date: March 2014 |
|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 1: *Basic Research* | | R-1 Program Element (Number/Name)<br>PE 0601103N *I University Research Initiatives* | | | |
| • Congressional General Reductions | -11.151 | - | - | - | - |
| Adjustments | | | | | |
| • Congressional Add Adjustments | 20.000 | - | - | - | - |

| Congressional Add Details ($ in Millions, and Includes General Reductions) | FY 2013 | FY 2014 |
|---|---|---|
| **Project:** 9999: *Congressional Adds* | | |
| Congressional Add: *University Research Program (Cong)* | 18.334 | - |
| Congressional Add Subtotals for Project: 9999 | 18.334 | - |
| Congressional Add Totals for all Projects | 18.334 | - |

**Change Summary Explanation**

Technical: N/A

Schedule: N/A

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 1 | R-1 Program Element (Number/Name)<br>PE 0601103N / *University Research Initiatives* | Project (Number/Name)<br>0000 / *University Research Initiatives* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000: *University Research Initiatives* | - | 99.521 | 112.617 | 113.908 | - | 113.908 | 116.196 | 118.764 | 120.901 | 120.901 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 innovation, 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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** DEFENSE UNIVERSITY RESEARCH INSTRUMENTATION PROGRAM (DURIP) | 17.342 | 22.226 | 22.596 |
| ***Description:*** 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 $1.5M. The DURIP program is an Office of the Secretary of Defense (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. DURIP is a one year program. | | | |
| ***FY 2013 Accomplishments:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601103N / *University Research Initiatives* | **Project (Number/Name)**<br>0000 / *University Research Initiatives* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued competition for research instrumentation awards to universities.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014. | | | |
| ***Title:*** MULTIDISCIPLINARY UNIVERSITY RESEARCH INITIATIVE (MURI)<br>***Description:*** Research efforts include high priority topics that intersect more than one traditional discipline. MURI topics are selected to address Naval Science and Technology (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. MURI is a five year program.<br>FY 2014 increased in funds to accommodate the increased number of new starts in FY 2014.<br>***FY 2013 Accomplishments:***<br>- Continued competition for new MURI awards to address selected high priority Naval S&T areas, transformational initiatives, and grand challenges, including strategically important DoD research areas. Approximately eight high priority research topics will be identified for publication in a BAA to solicit proposals.<br>- Continued MURI projects begun in prior years.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014. | 73.202 | 82.017 | 82.813 |
| ***Title:*** PRESIDENTIAL EARLY CAREER AWARDS (PECASE)<br>***Description:*** PECASE awards are made to academic scientists early in their research careers for extremely prestigious, single-investigator research in areas of vital importance to the Navy. Awards provide national recognition and research grants of up to | 8.977 | 8.374 | 8.499 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601103N / *University Research Initiatives* | **Project (Number/Name)**<br>0000 / *University Research Initiatives* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| $200K per year for five years. OSD, with policy and oversight responsibility for the PECASE program, directed that the number of PECASE awards be set at four new awards per year. PECASE is a five year program.<br><br>***FY 2013 Accomplishments:***<br>- Selected six outstanding university researchers to receive the five-year PECASE research award to conduct research of importance to the Navy.<br>- Continued PECASE programs begun in earlier years.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013, and award four new awards per OSD guidance.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, and award four new awards per OSD guidance. | | | |
| **Accomplishments/Planned Programs Subtotals** | 99.521 | 112.617 | 113.908 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**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.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 1 | R-1 Program Element (Number/Name)<br>PE 0601103N / *University Research Initiatives* | Project (Number/Name)<br>9999 / *Congressional Adds* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9999: *Congressional Adds* | - | 18.334 | - | - | - | - | - | - | - | - | - | 18.334 |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

This project shows Congressional Adds to this Program Element.
FY2013 Accomplishments. Facilitate waivers to augment limits for Defense University Research Instrumentation Program (DURIP) competition proposals for the acquisition of major equipment to augment current or develop new research capabilities in support of defense relevant research, and to increase all competitive based university research programs.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 |
|---|---|---|
| ***Congressional Add:*** University Research Program (Cong) | 18.334 | - |
| ***FY 2013 Accomplishments:*** Facilitate waivers to augment limits for Defense University Research Instrumentation Program (DURIP) competition proposals for the acquisition of major equipment to augment current or develop new research capabilities in support of defense relevant research, and to increase all competitive based university research programs. | | |
| ***FY 2014 Plans:*** N/A | | |
| **Congressional Adds Subtotals** | 18.334 | - |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

This project shows Congressional Adds to this Program Element.

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy* / BA 1: *Basic Research* | | | | | R-1 Program Element (Number/Name)<br>PE 0601152N / *In-House Lab Independent Res* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 16.561 | 18.230 | 18.734 | - | 18.734 | 19.126 | 19.499 | 19.852 | 19.852 | Continuing | Continuing |
| 0000: *In-House Lab Independent Res* | 0.000 | 16.561 | 18.230 | 18.734 | - | 18.734 | 19.126 | 19.499 | 19.852 | 19.852 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 that 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.

This PE addresses 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, and 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.

ILIR efforts are selected by Naval Warfare Centers/Lab Commanding Officers and Technical Directors 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.

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | Date: March 2014 |
|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 1: *Basic Research* | | | R-1 Program Element (Number/Name)<br>PE 0601152N *I In-House Lab Independent Res* | | |
| **B. Program Change Summary ($ in Millions)** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO** | **FY 2015 Total** |
| Previous President's Budget | 18.261 | 18.230 | 18.758 | - | 18.758 |
| Current President's Budget | 16.561 | 18.230 | 18.734 | - | 18.734 |
| Total Adjustments | -1.700 | - | -0.024 | - | -0.024 |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | -0.108 | - | | | |
| • SBIR/STTR Transfer | -0.049 | - | | | |
| • Rate/Misc Adjustments | - | - | -0.024 | - | -0.024 |
| • Congressional General Reductions Adjustments | -1.543 | - | - | - | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 1 | R-1 Program Element (Number/Name)<br>PE 0601152N / *In-House Lab Independent Res* | Project (Number/Name)<br>0000 / *In-House Lab Independent Res* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000: *In-House Lab Independent Res* | - | 16.561 | 18.230 | 18.734 | - | 18.734 | 19.126 | 19.499 | 19.852 | 19.852 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 (FNC's). 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 that 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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** ADVANCED MATERIALS | 2.941 | 2.918 | - |
| ***Description:*** Efforts include: structural materials; functional materials; maintenance reduction, hydrodynamics; power generation; energy conservation and conversion. | | | |
| ***FY 2013 Accomplishments:***<br>- Continued 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.<br>- Continued ILIR projects that are intended to be approximately three years in length. Projects selected for FY 2012 will focus on supporting Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility initiatives in Undersea Weaponry and Naval Engineering.<br>- Completed FY 2011 initiated ILIR projects during FY 2013.<br>- Completed research for Biaxial Fatigue in Corrosive Environment with the overall effort to: (1) characterize the biaxial fatigue behavior in a corrosive environment, comparing with that in air, (2) identify the basic mechanism of environment-assisted biaxial fatigue cracking, (3) expand the model for corrosion fatigue crack growth under biaxial loading, and (4) demonstrate and validate the model in the application to aircraft structure. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Completed research for Control and Dispersion of Electromagnetic Energy Using Metamaterials, where the dispersion and control of electromagnetic (EM) waves in the microwave (RF) region, using fabricated metamaterial structures, were demonstrated. Six metamaterial structures were modeled using in-house programs, DOD supercomputer resources, and High Frequency Structure Simulation (HFSS) software, and fabricated use photolithography, vapor deposition, and chemical and reactive ion etching. Scattering parameters (transmittance and reflectance), were acquired using a Network Analyzer coupled to a free space analysis setup.<br>- Completed research for Polyurea Silicate Composites. The objective of this research is to identify the structural transitions and interactions of the polyurea and nanoparticle that underlie the enhanced mechanical mechanisms for the protective response of polyurea nanocomposites. The approach is to use small angle and wide angle x-ray scattering (SAXS and WAXS) simultaneously with tensile and recovered impact tests to obtain a fundamental understanding of the polyurea nanoparticle effect at the molecular level. The strain rate material responses, both elastic and plastic, would be incorporated into a constitutive equation needed for modeling and for hydrocode simulations for further calculations of optimized geometries and layer thicknesses.<br>- Initiated fundamental research on high strength nanostructures/nanomaterials.<br>- Initiated research for new concepts, configurations, and applications for metamaterials.<br>- Initiated research for high temperature alloys for engine applications.<br>- Initiated research for low-cost, high-strength material repair.<br>- Initiated ILIR projects that are intended to be approximately three years in length. Projects selected for FY 2013 will focus on supporting Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility initiatives in Undersea Weaponry and Naval Engineering.<br>***FY 2014 Plans:***<br>Efforts in this R2 project have been continued in FY 2014 in the new ILIR Program.<br>***FY 2015 Plans:***<br>N/A | | | |
| ***Title:*** ELECTRONICS SENSOR SCIENCES<br>***Description:*** Description: 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.<br>***FY 2013 Accomplishments:***<br>- Continued 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. | 2.190 | 2.178 | - |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued research for computer vision techniques on optical and acoustic sensor data for underwater object detection and classification.<br>- Continued research for wideband retro-reflective arrays.<br>- Continued research on an application of Green's function technique to explore exotic and unexpected nano-phenomena in the electromagnetic scattering of finite-length nanowires. This effort has broad applicability to a variety of nano devices, such as: nano-antennas; nano-lasers; nanosensors; subwavelength photonic integration; and metamaterial designs.<br>- Continued research for high finesse optical domain radio frequency (RF) filters.<br>- Continued ILIR projects that are intended to be approximately three years in length. Projects selected for FY 2012 will focus on supporting Electric Power Sources and Multifunctional Electronics for Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Electromagnetic Gun and Persistent Surveillance, and the National Naval Responsibility in Undersea Weaponry.<br>- Completed FY 2011 initiated ILIR projects during FY 2013.<br>- Completed research for High Finesse Optical Domain RF Filters, where the objective is to design and fabricate a chip scale integrated optical<br>filter architecture with periodic flat passbands of narrow bandwidth compatible with conventional digital signal processing (i.e. < 50MHz) and<br>a finesse of 100 or greater. This type of filter design is previously unexploited in the optical domain and will help enable real time spectrum analysis and channelization in the photonic domain across multi-GHz RF signals.<br>- Completed research for Computer Vision Techniques on Optical and Acoustic Sensor Data for Underwater Object Detection and Classification. The goal of this research is to use advances in machine learning and computer vision to utilize optical and acoustic sensors in concert for object detection and classification in underwater applications. This technology can be used for object identification in a multitude<br>of scenarios, as well as for visual surveillance of a harbor. Furthermore, advanced computer vision can be used for self localization of an underwater vehicle. A specific goal of the research will be object detection and classification of mines found on the sea floor.<br>- Completed research for Wideband Retro-Reflective Arrays. Metamaterial transmission lines (MTMs) are proposed to be investigated for the design of a wideband, retroreflective Van-Atta array. The technical objectives of the project are to explore the basic science behind metamaterial transmission line technologies and their practical implementation. The goal is to achieve enhanced bandwidth and increased gain performance of a Van-Atta array that is compact in size for low-observable, retro-reflective applications.<br>- Initiated research for Wireless Highly Reliable Networks.<br>- Initiated research for the Optimization of Autonomous ASW Sensor Suites.<br>- Initiated research for Nano-sensor Technology.<br>- Initiated research for Nano-circuit Devices.<br>- Initiated research on Advanced Chem-Bio Sensor and Detection. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiated ILIR projects that are intended to be approximately three years in length. Projects selected for FY 2013 will focus on supporting Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility initiatives in Undersea Weaponry and Naval Engineering.<br>***FY 2014 Plans:***<br>Efforts in this R2 project have been continued in FY 2014 in the new ILIR Program.<br>***FY 2015 Plans:***<br>N/A | | | |
| ***Title:*** ENERGY SCIENCES<br>***Description:*** Description: Efforts include: undersea weaponry; energetic materials and propulsion; directed energy; and TeraHertz Time-Domain Spectroscopy (THz-TDS) technology that addresses overseas contingency operations and Counter Improvised Explosive Device (C-IED) detection by detecting and spectroscopically identifying military and home-made explosives and formulations.<br>***FY 2013 Accomplishments:***<br>- Continued 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.<br>- Continued research on the microbial biosynthesis of critical energetic ingredients.<br>- Continued research for accelerated quantum chemistry simulations of energetics using a novel metadynamics approach.<br>- Continued research for convergent synthesis of high performance heterocycles via late amination.<br>- Continued research to investigate the dispersion and control of electromagnetic (EM) waves in the microwave (RF) region using fabricated metamaterial structures.<br>- Continued ILIR projects that are intended to be approximately three years in length. Projects selected for FY 2012 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.<br>- Completed FY 2011 initiated ILIR projects during FY 2013.<br>- Completed the research on the Microbial Biosynthesis of Critical Energetic Ingredients which investigated new methods of microbial synthesis in the production of feedstocks for energetics. Microbial synthesis is the controlled harvesting of organic molecules from biological factories such as E. coli. It is hypothesized that large scale control and manipulation of these efficient microbial factories could lead to increased availability of traditionally rare feedstocks, enhanced sustainability due to the reduced need for organics from non-petroleum-derived feedstocks, and the significant reduction of hazardous waste.<br>- Completed the research for Accelerated Quantum Chemistry Simulations of Energetics using a Novel Metadynamics Approach, the goal of which is to develop methods based on a metadynamics approach that can predict important chemical properties of | 1.149 | 1.144 | - |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| energetic materials and additives that are normally inaccessible to first-principles simulation. The main properties used to evaluate the method are uni- and bimolecular decomposition barriers, oxidation reactions, accelerated aging studies, and crystalline density predictions. The focus will be on complex or<br>novel systems that have previously been difficult to simulate, such as polymer chains, novel high-nitrogen explosives, and organometallic compounds.<br>- Completed the research for Convergent Synthesis of High Performance Heterocycles via Late Amination, which focuses on convergent synthesis of energetic, high nitrogen CHNO heterocycles using novel energetic synthons to provide increased performance to Navy ordnance.<br>Designing higher heats of formation and higher densities into novel energetic CHNO compounds, while retaining good kinetic stability and safety properties, requires new structural motifs. The 1,2,3,4-tetrazine 1,3-dioxide structural motif, first described by Tartakovsky et al. in the<br>1991 synthesis of benzo tetrazine dioxide, remains an undeveloped energetic synthon. Although furazano tetrazine dioxide has been known for the last decade, its energetic properties are still unknown. The synthetic routes chosen are expected to permit ready transition to the pilot level and offer reasonably priced materials.<br>- Initiated research for High-Output, Low-Cost Energetic Materials<br>- Initiated research for High-Speed Energetic Weapons.<br>- Initiated research on Fundamental Development of Polymer Materials with Tunable Energy Levels.<br>- Initiated Research for High-Density, High-Output Batteries.<br>- Initiated ILIR projects that are intended to be approximately three years in length. Projects selected for FY 2013 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.<br>***FY 2014 Plans:***<br>Efforts in this R2 project have been continued in FY 2014 in the new ILIR Program.<br>***FY 2015 Plans:***<br>N/A | | | |
| ***Title:*** HUMAN PERFORMANCE SCIENCES<br>***Description:*** Description: 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).<br>***FY 2013 Accomplishments:*** | 1.833 | 1.821 | - |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued 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.<br>- Continued research for characterization of decision making behaviors associated with Human Systems Integration (HSI) design tradeoffs.<br>- Continued research for Localization of human spatial processing using dense-array Electroencephalography.<br>- Continued Integration of an implantable potentiostat for continuous monitoring of Nitric Oxide (NO) into a rat model of Hyperbaric Oxygen (HBO) toxicity.<br>- Continued research to characterize the naturalistic decision making processes used in Naval Aviation acquisition programs to assess cost, schedule and performance tradeoffs within and between Human Systems Integration (HSI) domains. Content analysis will be performed to identify knowledge, skills, abilities, heuristics, and biases associated with HSI decision making.<br>- Continued ILIR projects that are intended to be approximately three years in length. Projects selected for FY 2012 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.<br>- Completed FY 2011 initiated ILIR projects during FY 2013.<br>- Completed research for Characterization of Decision Making Behaviors Associated with Human Systems Integration (HSI) Design Tradeoffs,<br>where analysis is performed to identify knowledge, skills, abilities, heuristics, and biases associated with HSI decision making. This incorporates a coding study to gauge inter-rater reliability as part of the content analysis. The results will be used to (a) generate assessment test materials for a follow-on decision making experiment, and (b) create a summary of the recorded HSI tradeoff case studies, including key learnings and a description of tradeoff decision requirements.<br>- Completed research for Localization of Human Spatial Processing using Dense-array Electroencephalography. Aviation mishap statistics<br>confirm that in-flight spatial disorientation (SD) poses one of the greatest human factor problems for military aviators. The impact of this cognitive threat costs the DoD an average of 20 aircraft and 25 flight personnel annually. Recent animal research has identified specialized neural structures involved in spatial orientation. The objective of this research is to determine if spatial neural mechanisms found in animal<br>studies and in human functional magnetic resonance imaging tests can be further localized and defined by introducing limited ranges of normal<br>human motion.<br>- Completed Integration of an Implantable Potentiostat for Continuous Monitoring of Nitric Oxide (NO) into a Rat Model of Hyperbaric Oxygen (HBO) Toxicity. The U.S. Navy has long used oxygen breathing for covert underwater operations. The major limitation to HBO is the risk of HBO-induced pulmonary and central nervous system toxicity. NO is a critical second messenger involved in the pathophysiology of HBO-induced toxicity. The study examines an implantable NO sensor in conjunction with both | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| traditional and experimental implantable potentiostats. This work will lead to the development of new research capabilities to measure NO production in vivo.<br>- Initiated research for Brain and Spinal (and other) Injury Due to Shock Blast.<br>- Initiated research for Adaptive Learning Tools Based on Individual Awareness.<br>- Initiated research for Warfighter Impact Due to Operational Noise on Navy Ships.<br>- Initiated ILIR projects that are intended to be approximately three years in length. Projects selected for FY 2013 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.<br>***FY 2014 Plans:***<br>Efforts in this R2 project have been continued in FY 2014 in the new ILIR Program.<br>***FY 2015 Plans:***<br>N/A | | | |
| ***Title:*** INFORMATION SCIENCES | 1.853 | 1.846 | - |
| ***Description:*** Description: 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 optimalresource allocation and usage; modeling and computational propagation; seamless, robust connectivity and networking and cyber warfare.<br>***FY 2013 Accomplishments:***<br>- Continued 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.<br>- Continued research for the numerical analysis and design of methods for Partial Differential Equations (PDE) constrained optimization.<br>- Continued research for framework for collaborative robotic asset management.<br>- Continued research to develop a theory of Systems-of-Systems (SoS) network engineering and analysis based on the theory of time series of attributed graphs to understand how such systems can be mathematically formulated, simulated, analyzed, and tested.<br>- Continued ILIR projects that are intended to be approximately three years in length. Projects selected for FY 2011 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.<br>- Completed FY 2011 initiated ILIR projects during FY 2013. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Completed research for the Numerical Analysis and Design of Methods for Partial Differential Equations (PDE) Constrained Optimization.PDE Constrained Optimization problems arise in many areas of science and engineering, and include problems such as optimal shape design and parameter estimation. While advanced methods for general, non-linear optimization have existed for over a half century, the existence of PDE constraints in optimization problems make the existing optimization methods at best inefficient, and often times infeasible. The goal is to design and analyze new methods which build on previous efforts developed over the last decade, and enable these new methods to be used on problems currently seen in the analysis of naval systems.<br>- Completed research for Systems-of-Systems (SoS) Network Analysis where the design of Systems-of-Systems (SoS) requires careful analysis of not only the subsystems, but also the interconnections between the subsystems. These interconnections could possibly correspond to dependencies, communications, shared information, joint operation, or other relationships. This research seeks to develop a theory of SoS engineering and analysis based on graph theory, in particular the theory of time series of attributed graphs, in which the vertices and edges may have attributes (such as readiness levels or communication throughput). This theory will involve both a mathematical formulation of the SoS problem, but also a consideration of how such systems can be simulated, analyzed, and tested.<br>- Completed research for Framework for Collaborative Robotic Asset Management where a formalized and extensible approach for discovering,modeling, monitoring, and managing a distributed collection of disparate unmanned systems is defined. This framework will support near real-time system modeling, resource appraisal, and brokering functionalities while using scalable, abstract representations of mission, job,and resource capabilities to provide new levels of intelligent resource utilization to the Navy. The proposed work directly supports research initiatives in the areas of underwater communication networks, minimal operator intervention, intelligent decision-making, and promotes increased situational awareness. This project will present the design of a hierarchical architecture of software components and definition of the elements that comprise the framework Knowledge Representation Scheme in order to provide deliberative management capabilities for a system of collaborating robotic assets.<br>- Initiated research on Weak Signature Identification.<br>- Initiated research on Advanced Target Classification.<br>- Initiated research on Collaborative Unmanned Systems Communication and Asset Management<br>- Initiated ILIR projects that are intended to be approximately three years in length. Projects selected for FY 2013 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing,and the National Naval Responsibility in Undersea Weaponry. | | | |
| ***FY 2014 Plans:***<br>Efforts in this R2 project have been continued in FY 2014 in the new ILIR Program. | | | |
| ***FY 2015 Plans:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| N/A | | | |
| ***Title:*** NAVAL PLATFORM DESIGN SCIENCES | 1.266 | 1.257 | - |

***Description:*** Description: Efforts include: novel hull forms, materials, structures and signatures; and virtual shaping concepts for structures and platforms.

***FY 2013 Accomplishments:***
- Continued 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.
- Continued research for high fidelity, Reynolds-averaged Navier-Stokes (RANS) cavitation simulation.
- Continued research for development of a new vehicle dynamics-based motion planning and control algorithm into the motion planning process.
- Continued research for wall pressure fluctuation measurements in high Reynolds number turbulent pipe flow.
- Continued research to characterize the biaxial fatigue behavior of carrier-based aircraft in a corrosive environment, identify the basic mechanism of environment assisted biaxial fatigue cracking, develop an accurate model for corrosion fatigue crack growth under biaxial loading, and demonstrate and validate the model in the application to aircraft structure.
- Continued ILIR projects that are intended to be approximately three years in length. Projects selected for FY 2012 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.
- Completed FY 2011 initiated ILIR projects during FY 2013.
- Completed Optical Propagation Studies for Non-Line-of-Sight (NLOS) Underwater Laser Communications. This project's objective investigated the fundamental propagation characteristics of "broad beam", or diffused, light sources for N-LOS optical links. N-LOS links provide the benefits of decreased pointing-and-tracking complexity, increased time for link closure, and decreased sensitivity to obstructions.
This project studied how the spatial distribution of light caused by scattering, or shaping of the initial source beam distribution, affects the
propagation of modulated light in water and optimal source distributions matched to particular undersea environments.
- Completed research for Turbulent Wake Characterization, where understanding the details of complex turbulent flows around a submerged body is critical for analysis of a propulsor operating in its wake. The inflow characteristics to the propulsor have a significant impact on its performance. This project focuses on predicting the turbulent wake characteristics of a submerged, appended, model-scale body using Large
Eddy Simulation (LES) techniques. Because the propulsor impacts the pressure field, it has an effect on its own inflow; therefore, the ultimate goal of this project will be to model a propulsor and an appended body in the same domain using LES.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Completed research for Surface Piercing Strut Wake Signature Reduction. Surface piercing struts in motion relative to water generate a fairly complex wave, producing a rising bow wave in the front of the strut, a cavity on the sides and a wake behind. The size of this white water wake is a function of the strut shape, Reynolds number (Re), Froude number (Fr), water salinity, surfactants, etc. The objective of this effort is to understand the bubble generation and transport phenomena, ideally minimizing the bubble entrainment visual detection to a level comparable to the strut itself. Two approaches are investigated: 1) an experimental method that provides insight into the physics of the flow field; and 2) a computational method that validates the existing results and tests new concepts.<br>- Initiated research for Littoral Mine Detection and Avoidance.<br>- Initiated research for Compact Broad Band Low Frequency Sonar.<br>- Initiated research for Advanced Obstacle Avoidance for Unmanned Systems.<br>- Initiated ILIR projects that are intended to be approximately three years in length. Projects selected for FY 2013 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry<br>***FY 2014 Plans:***<br>Efforts in this R2 project have been continued in FY 2014 in the new ILIR Program.<br>***FY 2015 Plans:***<br>N/A | | | |
| ***Title:*** OCEAN SPACE SCIENCES<br>***Description:*** Efforts include: Littoral Geosciences, Optics, and biology; Marine Mammals; Ocean Acoustics; and autonomous systems.<br>***FY 2013 Accomplishments:***<br>- Continued 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.<br>- Continued optical propagation studies for Non-Line-of-Sight (NLOS) underwater laser communications.<br>- Continued research for turbulent wake characterization<br>- Continued research for surface piercing strut wake signature reduction.<br>- Continued research to assess the effects of Mid-Frequency Active (MFA) sonar on the movement of fish species in a natural environment, to compare the behavior and movement of fish prior to exposure to sonar, during exposure, and for a significant amount of time post-exposure to provide valuable data on fish behavior, movement, and survival following exposure to highintensity,tactical MFA sonar. | 3.256 | 3.236 | - |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued ILIR projects that are intended to be approximately three years in length. Projects selected for FY 2012 will focus on supporting Naval Battlespace Awareness, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and National Naval Responsibility initiatives in Ocean Acoustics and Undersea Weaponry.<br>- Completed FY 2011 initiated ILIR projects during FY 2013.<br>- Completed Optical Propagation Studies for Non-Line-of-Sight (NLOS) Underwater Laser Communications. This project's objective investigated the fundamental propagation characteristics of "broad beam", or diffused, light sources for N-LOS optical links. N-LOS links provide the benefits of decreased pointing-and-tracking complexity, increased time for link closure, and decreased sensitivity to obstructions.<br>This project studied how the spatial distribution of light caused by scattering, or shaping of the initial source beam distribution, affects the propagation of modulated light in water and optimal source distributions matched to particular undersea environments.<br>- Completed research for Turbulent Wake Characterization, where understanding the details of complex turbulent flows around a submerged body is critical for analysis of a propulsor operating in its wake. The inflow characteristics to the propulsor have a significant impact on its performance. This project focuses on predicting the turbulent wake characteristics of a submerged, appended, model-scale body using Large Eddy Simulation (LES) techniques. Because the propulsor impacts the pressure field, it has an effect on its own inflow; therefore, the ultimate goal of this project will be to model a propulsor and an appended body in the same domain using LES.<br>- Completed research for Surface Piercing Strut Wake Signature Reduction. Surface piercing struts in motion relative to water generate a fairly complex wave, producing a rising bow wave in the front of the strut, a cavity on the sides and a wake behind. The size of this white water wake is a function of the strut shape, Reynolds number (Re), Froude number (Fr), water salinity, surfactants, etc. The objective of this effort is to understand the bubble generation and transport phenomena, ideally minimizing the bubble entrainment visual detection to a level comparable to the strut itself. Two approaches are investigated: 1) an experimental method that provides insight into the physics of the flow field; and 2) a computational method that validates the existing results and tests new concepts.<br>- Initiated research for Littoral Mine Detection and Avoidance.<br>- Initiated research for Compact Broad Band Low Frequency Sonar.<br>- Initiated research for Advanced Obstacle Avoidance for Unmanned Systems.<br>- Initiated ILIR projects that are intended to be approximately three years in length. Projects selected for FY 2013 will focus on supporting Naval Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry. | | | |
| ***FY 2014 Plans:***<br>Efforts in this R2 project have been continued in FY 2014 in the new ILIR Program. | | | |
| ***FY 2015 Plans:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| N/A | | | |
| ***Title:*** IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR) | - | - | 12.908 |

***Description:*** Starting in FY 2015, these requirements have been consolidated into a separate R-2 project to provide greater visibility of the program by providing an easily navigable overview of all In-House Laboratory Independent Research (ILIR) Programs in a single location.

***FY 2013 Accomplishments:***
N/A

***FY 2014 Plans:***
- Completed research on how stresses and environment affect Aeta-phase precipitation in Al-Mg Alloys.
- Completed the development of algorithms and simulation environment which addressed key issues in order to find approximate solutions to the coverage problem for static (wireless sensor networks) WSNs and dynamic WSNs (or UxVs).
- Completed dynamic hybrid routing algorithm for Under Sea Sensors with integrated localization and tracking that may be implemented in a distributed manner, such that each node of such a network can intelligently and autonomously determine a wise routing strategy.
- Completed research on increased weapon lethality focused on the design and synthesis of aluminum based cluster compounds so as to increase their reaction rates to the order of common CHNO High Explosives (HE).
- Completed the development and investigation of new magnetoelastic/piezoelectric composite materials and technology that combine extraordinary magnetoelectric (ME) coupling of composites with broadband tunability needed for applications such as sensitive magnetic sensors, transducers for sonar and energy harvesting.
- Completed Principal Dynamic Mode (PDM) analysis to test the feasibility of detecting a mild emotional stressor and comparison of its performance against the standard power spectral density approach.
- Completed effects of CO2 tolerance training on the incidence of high altitude pulmonary edema in rodents.
- Completed investigation of the neural correlates of posttraumatic stress disorder (PTSD), both before and after clinical therapy, to discover the neural circuits most affected by the disorder and to use this information to optimize treatment strategies
- Completed development of quantum codes and methods of construction, and verify their theoretical performance through various types of noise. Of particular interest are constructions that perform optimally through the Amplitude Damping channel.
- Completed efforts to generate sharp and accurate images from synthetic aperture sonar (SAS) by utilizing Adjoint Control Filters for Nonlinear Partial Differential Equations.
- Completed Automatic Code Parallelization utilizing Genetic Programming, where the computer code takes full advantage of the available parallel computers.
- Completed effort addressing the problem of flow noise and flow induced vibration experienced by hull mounted and towed SONAR arrays.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Completed Sampling-Based Model Predictive Optimization With Application to Robot Kinodynamic Motion Planning for naval vehicles.<br>- Completed parametric study of the effects displacement and step location have on the performance of a stepped planing hull for high speed naval craft.<br>- Completed fundamental performance limitations imposed by acoustic interference on active sonar systems, concentrating on undersea networks in acoustically congested environments.<br>- Completed embedded graph systems for robust, coordinated control of heterogeneous unmanned system networks.<br>- Completed research for the Improved Understanding of Complex Flow Distribution over Towed Arrays.<br>- Initiated ILIR projects that were intended to be approximately three years in length including:<br>- Initiated research for polymer materials to understand improved helmet blast protection.<br>- Initiated fundamental research for composite materials for reduced signature for undersea vehicles.<br>- Initiated research for the fundamental understanding of graphene type Radio Frequency (RF) Antennas.<br>- Initiated research for complex unmanned sensor networks. | | | |
| ***FY 2015 Plans:***<br>-Continue all efforts of FY 2014, less those noted as completed.<br>-Continue research for polymer materials to understand improved helmet blast protection.<br>-Continue fundamental research for composite materials for reduced signature for undersea vehicles.<br>-Continue research for the fundamental understanding of graphene type Radio Frequency (RF) Antennas.<br>-Continue fundamental research for the understanding of optimization of undersea sensor distribution in littoral environments.<br>-Continue research for understanding effects of energetic materials under high pressure environment.<br>-Continue research on Operational Fatigue of Warfighters due to Stress Environments.<br>-Continue research on Human Gesture and Computer Interface and Functionality.<br>-Continue research framework for Efficient Quantum Computing.<br>-Continue research for Autonomous Routing of Unmanned Vehicles.<br>-Continue fundamental research for undersea imaging and analysis.<br>-Continue research framework for Efficient Quantum Computing.<br>-Continue research for Autonomous Routing of Unmanned Vehicles.<br>-Continue fundamental research for undersea imaging and analysis.<br>-Continue research for modeling super-cavitation of Advanced Propulsor Designs.<br>-Continue research for Predictive Performance Modeling of Advanced Naval Hull Designs.<br>-Continue research for Design and Performance of High Speed Naval Vessels.<br>-Continue research for Advanced Smart Wireless Cooperative Vehicular Network.<br>-Continue research for Undersea Laser Communication and Identification in Littoral Environments. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| -Continue ILIR projects that are intended to be approximately three years in length researching littoral geosciences, optics, and biology; marine mammals; ocean acoustics; and autonomous systems.<br>Complete FY 2013 initiated ILIR projects in many disciplines including:<br>-A New Method to Generate Self-Adaptive Grid Point.<br>-Energy Harvesting for Future Embedded Diagnostics Capability.<br>-Sensorless Failover Design in High Criticality/High Performance Applications.<br>-Advanced Coding for Communication Links and Active Sensors The Role of Electrical Anomalies in Energetic Materials.<br>-Direct Identification of Malaria Liver Stage vaccine Targets.<br>-Reproductive Toxicity of Jet Propellant -5 (JP-5) and Alternative Jet Fuel Mixtures.<br>-Diagnostics Capability Magnetostrictive Characterization and Modeling of HY100.<br>-Directional Spreading of wind Waves.<br>-Supercavitation - Impulsively Translated Projectiles.<br>-Assessing the Effect of Biological Agent Ingestion.<br>-Synthesis of Novel High Nitrogen Energetic Compounds by Simultaneous Shear and Pressure Loading.<br>-Synthesis of Novel Tetraazapentalenes as HighPerformance, Insensitive Energetic Materials.<br>-Affine-Invariant, Elastic Shape Analysis of Planar.<br>-Highly Squinted Monopulse Synthetic Aperture Radar.<br>-Estimation of Applied Forces Acting on a Ribbed Plate.<br>-Plate Effect of Polyurea on the Shock Response of Composite Materials.<br>-High Data Rate Undersea Laser Communication.<br>-Machine Learning for Multi-Modal Data Analysis.<br>-Sensorless Failover Design in High Criticality/High Performance Applications<br>-Energy Harvesting for Future Embedded Diagnostics Capability<br>-Initiate FY 2015 ILIR projects that are intended to be approximately three years in length to research topics including :Structural materials, functional materials, maintenance reduction, hydrodynamics, power generation, energy conservation and conversion.<br>-Complete research to develop broadband dynamically controllable artificial dialetrics.<br>-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.<br>-Undersea weaponry, energetic materials and propulsion, directed energy, and TeraHertz Time-Domain Spectroscopy (THz-TDS) technology that addresses overseas contingency operations and Counter Improvised Explosive Device (C-IED) detection by detecting and spectroscopically identifying military and home-made explosives and formulations.<br>-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). | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| -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.<br>-Novel hull forms, materials, structures and signatures; and virtual shaping concepts for structures and platforms.<br>-Littoral geosciences, optics, and biology; marine mammals; ocean acoustics; and autonomous systems.<br>-Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility initiatives in Undersea Weaponry and Naval Engineering.<br>-Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry.<br>-Command and Control and connectivity research. | | | |
| ***Title:*** SCIENCE TECHNOLOGY ENGINEERING AND MATH (STEM) EFFORTS AT NAVY LABS | 2.073 | 3.830 | 5.826 |
| ***Description:*** Description: This effort will support both the Science and Engineering Apprenticeship Program (SEAP) and the Naval Research Enterprise Intern Program (NREIP) summer programs to encourage participating students to pursue science and engineering careers, to further their education via mentoring by laboratory personnel and their participation in research, and to make them aware of DoN research and technology efforts, which can lead to employment within the DoN. Participating students will spend eight to ten weeks during the summer doing research at approximately 19 to 20 DoN laboratories. Participants will receive a stipend distributed by the Contractor. The stipend is a monthly allowance paid to interns for their participation in the research efforts.<br><br>This activity is created starting in FY 2013 to highlight Science Technology Engineering and Math (STEM) efforts at Navy labs that were previously funded within the Ocean/Space Sciences activity in this PE.<br>The increase in the STEM Efforts is in response to the Secretary of the Navy's commitment to doubling the Navy's investment and establishing a strong naval STEM program over the next five years.<br><br>***FY 2013 Accomplishments:***<br>- 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.<br>- Initiate Science, Technology, Engineering and Mathematics (STEM) projects that are intended to be approximately three years in length. Projects selected for STEM funding will focus on engaging and educating future Naval scientists and engineers and | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601152N / *In-House Lab Independent Res* | **Project (Number/Name)**<br>0000 / *In-House Lab Independent Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| incorporating naval relevance, diversity, and STEM best practices. These efforts will complement and support the ongoing independent research, education and outreach efforts taking place at the Naval laboratories.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2013 | | | |
| **Accomplishments/Planned Programs Subtotals** | 16.561 | 18.230 | 18.734 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**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 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.

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | | Date: March 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 1: *Basic Research* | | | | | R-1 Program Element (Number/Name)<br>PE 0601153N *I Defense Research Sciences* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 433.080 | 488.387 | 443.697 | - | 443.697 | 451.763 | 470.745 | 477.972 | 479.279 | Continuing | Continuing |
| 0000: *Defense Research Sciences* | 0.000 | 424.830 | 484.387 | 443.697 | - | 443.697 | 451.763 | 470.745 | 477.972 | 479.279 | Continuing | Continuing |
| 9999: *Congressional Adds* | 0.000 | 8.250 | 4.000 | - | - | - | - | - | - | - | - | 12.250 |

# The FY 2015 OCO Request will be submitted at a later date.

**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 (Sep 2011). 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).

This PE addresses basic research efforts including 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); 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 five 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 attracts 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, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy* / BA 1: *Basic Research* | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* |

| B. Program Change Summary ($ in Millions) | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 473.070 | 484.459 | 493.716 | - | 493.716 |
| Current President's Budget | 433.080 | 488.387 | 443.697 | - | 443.697 |
| Total Adjustments | -39.990 | 3.928 | -50.019 | - | -50.019 |
| • Congressional General Reductions | - | -0.072 | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | 4.000 | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | - | - | | | |
| • SBIR/STTR Transfer | -9.205 | - | | | |
| • Rate/Misc Adjustments | - | - | -50.019 | - | -50.019 |
| • Congressional General Reductions Adjustments | -39.785 | - | - | - | - |
| • Congressional Add Adjustments | 9.000 | - | - | - | - |

| Congressional Add Details ($ in Millions, and Includes General Reductions) | FY 2013 | FY 2014 |
|---|---|---|
| **Project:** 9999: *Congressional Adds* | | |
| Congressional Add: *Nanotechnology Research (Cong)* | 8.250 | 4.000 |
| Congressional Add Subtotals for Project: 9999 | 8.250 | 4.000 |
| Congressional Add Totals for all Projects | 8.250 | 4.000 |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 1 | | | | | R-1 Program Element (Number/Name)<br>PE 0601153N / *Defense Research Sciences* | | | | Project (Number/Name)<br>0000 / *Defense Research Sciences* | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| 0000: *Defense Research Sciences* | - | 424.830 | 484.387 | 443.697 | - | 443.697 | 451.763 | 470.745 | 477.972 | 479.279 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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).

This PE addresses basic research efforts including 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); 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. Activities in this area also support maintenance of the Science and Engineering Workforce and STEM Education and Outreach.

S&T investment in basic research also includes the National Naval Responsibilities (NNRs), S&T areas that are uniquely important to maintaining U.S. Naval superiority. With the designation in 2011 of Sea-Based Aviation as an NNR, there are currently five 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 attracts 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.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** AIR, GROUND AND SEA VEHICLES | 63.436 | 63.646 | 55.759 |
| ***Description:*** 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 | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| vehicles; air platforms propulsion and power; air platforms survivability and signature control; special aviation projects; Unmanned Air Vehicle/Unmanned Combat Air Vehicle (UAV/UCAV); environmental quality; logistics; power generation, energy conversion, and storage; and advancements in naval technology innovations.<br><br>Funding decrease in FY 2015 is the result of changing S&T investment priorities within the Department of the Navy.<br><br>Research planning activities associated with the new Sea Based Aviation National Naval Responsibility (SBA NNR) took place in FY 2012-13, with most projects starting in FY 2014.<br><br>Accomplishments and plans described below are examples for each effort category.<br><br>***FY 2013 Accomplishments:***<br>Air Vehicles<br>- Continued investigations into controlled initiation and recovery from aggressive, non-linear aero-maneuvers conducted by unmanned air vehicles.<br>- 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 shipboard operations, autonomous rotorcraft operations in shipboard environment, and innovative rotor design concepts for naval applications.<br>- Continued research in computational simulation of rotorcraft operations in a shipboard environment.<br>- Continued investigation of advanced structural concepts, providing a high degree of crew protection during crashes.<br>- Continued research into new analytical methods for high-fidelity prediction of rotorcraft performance, loads, and vibration.<br>- Continued university and Navy Lab research in basic rotorcraft science with emphasis on enabling concepts for variable geometry/variable rotor-speed aircraft.<br><br>Science of Autonomy<br>- Continued multi-disciplinary research into the science of autonomy, including multi-vehicle collaboration, intelligence, and human interaction.<br>- Continued research in scalable and robust distributed collaboration among autonomous systems.<br>- Continued research in human/unmanned system collaboration.<br>- Continued research in autonomous perception and intelligent decision-making.<br>- Continued research in intelligent architectures for autonomous systems.<br><br>Ship Concepts and Hydrodynamics | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - 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.<br>- Continued implementation of nationwide program to increase interest in naval engineering education.<br>- 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.<br>- Continued research in propeller tip vortex cavitation and sheet-to-cloud cavitation.<br>- Continued computational and experimental investigation into complex, three-dimensional flow separation problems.<br>- Continued modeling and understanding of full-scale circulation control bow planes design.<br>- Continued validation of Unsteady Reynolds Averaged Navier Strokes (URANS) prediction on maneuvering effects on ship motion in waves.<br>- Continued modeling of hydro-acoustics of advanced materials propulsor.<br>- Continued program to investigate renewable energy technologies for navy applications.<br>- Continued computational and experimental investigations of wakes in stratified fluids.<br>- Continued Large Eddy Simulation (LES) modeling of crashback of underwater vehicle with propulsor.<br>- Continued measurement and modeling of unsteady high-speed craft hydrodynamics.<br>- Continued high-fidelity fluid-structure interaction program.<br>- Continued computational prediction and validation of damaged ship maneuvering.<br>- Continued research efforts on multi objective optimization of hull shapes using hybrid hull concept to achieve high efficiency, reduced slamming loads and hydrodynamic/structural performance.<br>- Continued development of understanding of shockwave propagation and failure mechanisms of high strain rate, sensitive polymers and their interaction in composites with structural and armor materials.<br><br>Ship Signatures, Structures, and Materials<br>- 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.<br>- Continued modeling of alternating current sources and propagation.<br>- 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.<br>- Continued LDV of scaling effects studies of unsteady elastic duct and propulsor interaction in a wind tunnel.<br>- Continued pressure-shear experiments at ultra high loading rates of explosion resistant coating ERC in combination with light weight composites, including glass, acrylics, Poly(methyl methacrylate) (PMMA) and develop computational simulation capability for understanding the behavior and failure effect of ERC on the materials.<br>- Continued computational methods for simulation of fragmentation, including tracking interactions of fragments and their interactions with composites of various materials (and fluid fragment interaction).<br>- Continued effort on much higher strain rate loading and constitutive behavior of Explosion Resistant Coating (ERC) for strain | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| rates appropriate to ballistic events.<br>- Continued work on cohesive elements for dynamic fracture under combined mode for application to failure in joints in ship structures under blast loading.<br>- Continued work on hybrid ship (non-magnetic stainless steel/composite) hull concepts.<br>- 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.<br>- Continued concept for photonic band gap waveguide.<br>- Continued methods to model the mechanisms of interaction between an elastic duct wall and fluid-flow in a duct with a propeller.<br>- Continued development of computational mechanics to provide predictive capabilities of acoustics, linear and nonlinear dynamic response and failure mechanisms of structures.<br>- Continued efforts in alternative hull for fast ships and hybrid ship hull structures.<br>- Continued efforts in understanding of explosion resistant coating under extreme loads and its interaction with other armor and structural materials.<br>- Continued investigation into methods to control airborne noise transmission using active control.<br>- Continued development of metamaterial concepts for radio frequency (RF) signature control and photonic and acoustic applications.<br>- Continued 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.<br>- Continued study of droplet & volume scattering phenomena.<br>- Continued the development of predictive models for infrared emission and reflection from breaking waves.<br>- Continued development of computational electromagnetic tools for electromagnetic materials design & optimization.<br>- Continued development of a methodology for highly reliable composite to metallic joints.<br>- Continued fundamental efforts in multi-scale, time-varying, hull structural reliability models and processes for structural performance analysis.<br>- Continued 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.<br>- Continued development of advanced electro magnetic energy absorbing composite materials.<br>- Continued performing measurements of sea-slamming loads in fast ships at various sea states and speeds for composite panels on the experimental facility and developed/verified theoretical/computational models considering hydro elasticity and structural details and scale effects.<br>- Continued efforts to further the physics based understanding of structural acoustics for the next generation submarine.<br>- Continued improvements for predictive capabilities of surface ship propulsion system and underwater acoustic signatures.<br><br>Ship and Air Platform Machinery and Systems<br>- Continued efforts to understand and control the generation and propagation of far-field jet noise. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of Pulsed Detonation Engine (PDE) Technology.<br>- Continued development and understanding of control capabilities and distributed intelligence strategies for shipboard systems.<br>- Continued propulsion system cost-reduction efforts through reduction of vibration, noise and thermal fluctuation at the source by controlling combustion.<br>- Continued passive and active high speed noise control.<br>- Continued studies of alternate propulsion systems for PDE and generated prediction models.<br>- Continued investigation of thermal management approaches for cooling high power electronic devices.<br>- Continued research on non-vapor, compression based refrigeration cycles.<br>- Continued studies of advanced air-breathing propulsion concepts.<br>- Continued study of advanced materials for PDE applications.<br>- Continued efforts to expand the model based reasoning control algorithm approach to multiple heterogeneous systems.<br>- Continued studies of complexity in heterogeneous distributed control systems.<br>- Continued efforts to investigate a market based control approach to distributed control.<br>- Continued efforts to perform physics based modeling of fluid actuation systems.<br><br>Power Generation, Energy Conversion and Storage<br>- Continued evaluation of stability and control of electrical power systems.<br>- Continued analyzing synchronization of 19 diode lasers to produce intense beams.<br>- Continued efforts in nanostructures, novel electrolytes, and electrode materials to enable new, 3D, power source architectures and to improve capacity of rechargeable lithium and lithium-ion batteries.<br>- Continued exploration and development of materials for high energy density, passive power electronics (Capacitors).<br>- Continued expanding the fundamental understanding of direct electrochemical oxidation and the use of logistic fuels in solid oxide fuel cells.<br>- Continued development of phase change cooling approaches for high power electronic devices.<br>- Continued efforts developing a science base for optimized combustion of alternative fuels.<br>- Continued 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.<br>- Continued effort in energy and power management to include understanding and reliability of high power electronics.<br>- Continued investigation into rare earth-free permanent magnet materials.<br>- Continued modeling of positron confinement for ultra high-density energy storage and convened international positron confinement workshop.<br>-Continued investigating thermodynamic cycle analogy for harvesting waste heat using multiferroic (pyromagnetic & pyroelectric) materials. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued research into thermionic energy conversion using inter-gap molecular species in a heat cell with low work function materials.<br>- Continued research into cyber-physical, real-time distribution and control of power & energy networks, physics-based models,hardware-in-the-loop simulation.<br>- Continued development of novel approaches to deposition of ultra high quality SiC epilayers needed to enable high-voltage, highfrequency,high-power wide bandgap semiconductor devices.<br>- Continued study of fault tolerant electromechanical energy converter concepts for naval applications.<br>- Continued research to understand new energy conversion methods (pyroelectrics, thermionics, combustion).<br>- Continued basic research in next generation wide bandgap semiconductors.<br>- Initiated experimental and computational investigation of dynamic response of marine gas turbines for on-demand and flexible power supply.<br>- Initiated power and energy management science, particularly understanding new magnetic materials and sliding electrical contacts.<br><br>Advancements in Naval Technology Innovations<br>- Continued development of the Centers for Innovative Naval Technology (CINT), which will expand and apply the Center for Innovative Ship Design (CISD) approach to other Navy facilities to dramatically expand participation and the breadth of naval technologies covered. | | | |
| ***FY 2014 Plans:***<br>Air Vehicles<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Initiate Sea-Based Aviation NNR research in Virtual Dynamic Interface, Advanced Manned/Unmanned Handling Qualities and Control for Naval Operations, Improved Fixed Wing Launch and Recovery High Lift Aerodynamics and Performance, Enhanced Fixed Wing V/STOL Operations, and Autonomous Deck Operations.<br><br>Science of Autonomy<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Initiate research in integrated design analysis/prognosis to optimize airframe structural properties and match material selection to operational requirements.<br>- Initiate modeling of complex behaviors/interactions to predict risk, probability and mechanism of failure and forecast lifetime performance.<br><br>Ship Concepts and Hydrodynamics<br>- Continue all efforts of FY 2013, less those noted as completed above. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate research into the extension of bubble-wake modeling to physical far-field regime.<br><br>Ship Signatures, Structure, and Materials<br>- Continue all efforts of FY 2013, less those noted as completed above.<br><br>Ship and Air Platform Machinery and Systems<br>- Continue all efforts of FY 2013, less those noted as completed above.<br><br>Power Generation, Energy Conversion and Storage<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Complete materials research in positron storage.<br>- Complete insulation longevity prediction materials research.<br>- Initiate fundamental research in novel, high temperature, superconducting (HTS) material synthesis.<br><br>Advancements in Naval Technology Innovations<br>- Continue all efforts of FY 2013, less those noted as completed above. | | | |
| ***FY 2015 Plans:***<br>Air Vehicles<br>- Continue all efforts of FY 2014, less those noted as completed above.<br><br>Science of Autonomy<br>- Continue all efforts of FY 2014, less those noted as completed above.<br><br>Ship Concepts and Hydrodynamics<br>- Continue all efforts of FY 2014, less those noted as completed above.<br><br>Ship and Air Platform Signatures, Structures, and Materials<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Continue Sea-Based Aviation NNR structures and materials research in Structural Mode Characterization, High-Loading/ Lightweight Materials, Advanced Structural Concepts, Material Degradation/Corrosion, and Structural Protection and Maintenance.<br><br>Ship and Air Platform Machinery and Systems<br>- Continue all efforts of FY 2014, less those noted as completed above. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Sea-Based Aviation NNR propulsion research in Propulsion Cycles, Subsystems, and Integration, Turbomachinery and Drive Systems with Enhanced Maintainability, Jet Noise Reduction, Hot Section Materials and Coatings, and Small UAV Propulsion.<br><br>Power Generation, Energy Conversion and Storage<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Complete investigation into rare earth-free permanent magnet materials.<br>- Complete development of novel approaches to deposition of ultra high quality SiC epilayers needed to enable high-voltage, high-frequency, high-power wide bandgap semiconductor devices.<br>- Complete power and energy management science, particularly understanding new magnetic materials and sliding electrical contacts.<br>- Complete basic research in next generation wide bandgap semiconductors.<br><br>Advancements in Naval Technology Innovations<br>- Continue all efforts of FY 2014, less those noted as completed above. | | | |
| ***Title:*** ATMOSPHERE AND SPACE SCIENCES | 22.826 | 25.221 | 25.053 |
| ***Description:*** Efforts include: Marine Meteorology and Prediction, and Space Sciences.<br><br>Accomplishments and plans described below are examples for each effort category.<br><br>***FY 2013 Accomplishments:***<br>Marine Meteorology and Prediction<br>- 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.<br>- Continued the development of next-generation ocean-atmosphere coupled models.<br>- 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.<br>- Continued theoretical and observational effort to improve understanding of the fundamental dynamics of mountain waves, including generation, propagation, nonlinear interaction, and wave breaking.<br>- Continued effort to gain a fundamental understanding of the flow-dependent limits of predictability by combining research in data assimilation and atmospheric instability.<br>- Continued investigation into the near-earth environmental effects on electromagnetic propagation. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - 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.<br>- 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.<br>- 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).<br>- Continued assessment of the status of aerosol observation, prediction, and understanding for use in slant-range visibility and electro-optical performance prediction models.<br>- 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 WindSat instrument.<br>- 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.<br>- Continued 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.<br>- Continued effort to understand the fundamental physics and dynamics that control cloud and aerosol variability in the marine boundary layer.<br>- Completed 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.<br>- Initiated effort to improve understanding of sub-seasonal, seasonal and intra-seasonal oscillation in a fully coupled (air, sea, land, ice) Model with the goal of developing a seamless, high-resolution earth system prediction capability for extended range forecasts.<br>- Initiated the effort to understand the impact of skewness on our ability to estimate meteorological variables and their uncertainty.<br>- Initiated the effort to understand the predictability of weather in future extreme environments by quantifying how these changes impact forecast error growth and energy, non local errors and tropical cyclone prediction.<br>- Initiated the study to understand the interplay of deep convective and boundary layer processes in tropical cyclone eye/eyewall dynamics and symmetric/asymmetric inner-core variability through a combination of numerical models, observation and improving upon existing theory.<br><br>Space Sciences<br>- Continued assessment of advanced techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography.<br>- Continued program to develop advanced improvements to specification and prediction of the space environment to improve space system performance and their on-call availability. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - 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.<br>- 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.<br>- 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.<br>- Continued program to extend magneto-hydrodynamic 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.<br>- Continued effort to develop better physical understanding of small-scale atmospheric wave dynamics in the middle and upper atmosphere.<br>- Continued 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.<br>- Continued effort to develop and validate numerical models of high-energy solar energetic particle (SEP) and solar gamma-ray (SGR) emissions.<br>- Continued effort to develop a quantitative standard model for solar flares that satisfies ultra violet (UV)-X-ray observations; understand the origin, dynamics, and evolution of plasma in active region magnetic flux tubes.<br>- Continued 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.<br>- Continued 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.<br>- Continued 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.<br>- Continued effort to assemble individual databases and model components of the Sun-Earth System.<br>- Continued 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.<br>- Continued effort to test solar active region heating models and determine the most important heating mechanisms, understanding of which is essential for accurate solar radiative output predictions.<br>- Continued effort to develop spectroscopic techniques and derive required measurements to observe essential small scale solar coronal plasma processes, which are critical to understanding the solar atmosphere.<br>- Completed effort to test solar active region heating models and determine the most important heating mechanisms, understanding of which is essential for accurate solar radiative output predictions.<br>- Initiated effort to develop an accurate three-dimensional model of the solar wind in the inner heliosphere for use in space weather prediction codes, to improve forecasts of coronal mass ejection arrival time at earth. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiated effort to measure and model ionizing gamma radiation from terrestrial thunderstorms, towards quantifying the physical conditions under which thunderstorms become powerful sources of energetic particles and photons.<br>- Initiated effort to quantify the evolution of probability density functions for orbiting objects in a crowded space environment, which will help inform orbital debris mitigation and avoidance strategies.<br><br>***FY 2014 Plans:***<br>Marine Meteorology and Prediction<br><br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Complete analysis of results from major field project on air-sea interaction and transition improvements into applied research to improve the treatment of fluxes in coupled atmosphere-ocean prediction systems.<br>- Initiate investigation of tropical cyclone intensification and structure changes that occur in response to changes in upper level outflow, large scale environmental interactions and/or internal changes in convection using innovative new observing systems and satellite observations.<br><br>Space Sciences<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Complete 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.<br>- Complete assessment of advanced techniques and algorithms for remote sensing of ocean and atmospheric properties including winds, waves, currents, and surface topography.<br>- Complete effort 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.<br>- Complete effort to develop and validate numerical models of high-energy solar energetic particle (SEP) and solar gamma-ray (SGR) emissions.<br>- Complete 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.<br>- Complete 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.<br>- Complete 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.<br>- Complete field project to increase understanding of air-sea exchange of enthalpy (heat and moisture) to improve high-resolution coupled atmosphere-wave-ocean tropical cyclone prediction systems. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete effort to test solar active region heating models and determine the most important heating mechanisms, understanding of which is essential for accurate solar radiative output predictions.<br>- Complete effort to develop spectroscopic techniques and derive required measurements to observe essential small scale solar coronal plasma processes, which are critical to understanding the solar atmosphere.<br>- Initiate investigation into the coupling physics, dynamics, and chemistry from the lower atmosphere, earth surface, and ocean into the upper atmosphere and ionosphere, focusing on processes relevant to ionospheric specification and forecasting.<br>***FY 2015 Plans:***<br>Marine Meteorology and Prediction<br>- Continue all efforts of FY 2014, less those noted as completed above.<br><br>Space Sciences<br>- Continue all efforts of FY 2014, less those noted as completed above. | | | |
| ***Title:*** COUNTER IMPROVISED EXPLOSIVE DEVICE (IED) SCIENCES | 16.846 | 14.963 | 14.558 |
| ***Description:*** The 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, to advance anticipation, and affect the occurrence or potential occurrence of IED events. The program also seeks to establish and nurture a multidisciplinary counter-IED Science and Technology community of Government, academic and industry researchers to accelerate the transition of new science and technology into fielded systems.<br><br>Accomplishments and plans described below are examples for each effort category.<br><br>Funding decrease in FY 2014 us the result of reassignment of funding for the Basic Research Challenge Program into the newly created Research Activity.<br><br>***FY 2013 Accomplishments:***<br>- 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 of IED activities, analysis of communications, and knowledge management systems to combine diverse data sources.<br>- 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. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - 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.<br>- 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.<br>- 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.<br>- Continued creation of new spectroscopy for sensitive characterization of semiconductor nanostructures, ultrathin molecular films and chemical/biological threat materials and explosives.<br>- Continued 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.<br>- Continued development of a new chemical explosive detection concept based on pump/probe ultrashort pulse lasers.<br>- Continued research on characterizing background noise in urban and riverine environments in support of IED signature detection.<br>- Continued a Counter-IED Grand Challenge effort to pursue innovative device neutralization modalities, augmented by device detection technologies.<br>- Continued development of high performance polymer materials for armor applications.<br>- Continued effort to directly observe lattice deformations in explosives under shock impact.<br>- Continued analytical study to detect an intruder in proximity to an underwater pipeline using structure-guided acoustic waves.<br>- Continued increased emphasis on sociological and cultural aspects of defeating insurgent networks.<br>- Continued increased emphasis on standoff wide area neutralization and pre-detonation of IEDs.<br>- Continued increased emphasis on stronger lightweight armor including nanoparticle designs.<br>- Continued increased emphasis on detection of physical and temporal device characteristics.<br>- Continued effort to provide new representations and multi-physics algorithms that significantly extend the validity and efficiency of state-of-the-art Computational Fluid Dynamics capabilities and enable accurate computation of complex fluid dynamics.<br>- Continued increased emphasis on challenges within the Riverine environment.<br>- Continued increased emphasis on challenges in the temporal domain in various land environments.<br>- Initiated an effort to integrate observable behaviors with social behavior models to provide inputs for predictions and validation.<br>- Initiated a program to investigate nano-technologies applied to miniaturized remote molecular sensors, with an additional emphasis on low-fidelity detection of trace explosive vapor partial-pressures.<br>- Initiated research into emerging very-broad-band spectroscopic capabilities to achieve a low-fidelity mosaic of partial pressure detections of explosives.<br>- Initiated study of biomimetic nano composites.<br>- Initiated study of energy transduction through soft armor. | | | |
| ***FY 2014 Plans:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all effort of FY 2013, less those noted as completed above.<br>- Complete 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.<br>- Complete 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.<br>- Complete an effort to provide new representations and multi-physics algorithms that significantly extend the validity and efficiency of state-of-the- art Computational Fluid Dynamics capabilities and enable accurate computation of complex fluid dynamics.<br>- Complete a Counter-IED Grand Challenge effort to pursue innovative device neutralization modalities, augmented by device detection technologies.<br>- Complete an analytical study to detect an intruder in proximity to an underwater pipeline using structure-guided acoustic waves.<br>- Complete development of high performance polymer materials for armor applications.<br>- Initiate a Neutralize effort to investigate the identification of techniques to deflagrate or detonate explosives by creating hot spots or other localized effects that do not quench.<br>- Initiate a Neutralize effort to investigate new energy conversion schemes and extraction mechanisms for high-powered microwave sources that have potential to dramatically reduce the size, weight, and power required.<br>- Initiate a Neutralize effort to research compact wideband metamaterial multifunctional antennas.<br>- Initiate a Mitigate effort to explore new chemistry techniques to optimize polymer fiber growth and hardening.<br>- Initiate a Mitigate effort to develop in-situ analytical tools to observe nano to micro structure of materials during fabrication and treatment processes.<br>***FY 2015 Plans:***<br>- Continue all effort of FY 2014, less those noted as completed above.<br>- Complete a Neutralize effort to investigate emitter recognition and related network behavioral analysis.<br>- Complete a Mitigate effort to research multifunctional ballistic fibers with Custom Designed and Engineered Nanostructure.<br>- Complete work on neural correlates of cross-culture adaptation<br>- Complete work on distinguishing the optical signature of explosive molecules from background molecules.<br>- Initiate research on lightweight flexible materials that can selectively absorb, dissipate, and convert high energy electromagnetic waves or blast waves.<br>- Initiate research on compact and efficient high voltage pulsed switches that can rapidly charge and discharge at a high repetition rate.<br>- Initiate an effort to detect a wider variety of homemade explosives | | | |
| ***Title:*** HUMAN SYSTEMS | 18.800 | 21.213 | 17.180 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Description:*** Efforts include: Human factors and organizational design; manpower, personnel, and training; integrated avionics, displays, and advanced cockpit; and pattern recognition.<br><br>Accomplishments and plans described below are examples for each effort category.<br><br>Funding decrease in FY 2015 is the result of changing S&T investment priorities within the Department of the Navy.<br><br>***FY 2013 Accomplishments:***<br>- Continued research of social networks for counterterrorism.<br>- Continued expansion of the cognitive architectural modeling capability to increase coverage, including spatial reasoning, multitasking, and impact of physiological and stress variables.<br>- Continued research of human cognition and performance to create more realistic simulations for training.<br>- Continued program to combine cognitive architectures with computational neuroscience to better predict human performance.<br>- Continued program on implantable electronics for performance enhancement.<br>- Continued investment in natural language interaction capability for artificially intelligent training systems.<br>- Continued research of neuro-control of high-lift bio-inspired Unmanned Underwater Vehicles and active vision and cognitive navigation skills in mobile robots.<br>- Continued computational neuroscience for novel pattern recognition and sensory augmentation.<br>- Continued research of human-robot interaction to support team collaboration.<br>- Continued 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.<br>- Continued investigation of human sensory performance for optimizing video and audio human-electronic device interfaces.<br>- Continued 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.<br>- Continued research of advanced biometrics such as biodynamic signatures to support spirals 2 and 3 of the Navy Identity Dominance System - Maritime Domain.<br>- Continued efforts to extend the representational capabilities of cognitive architectures to accommodate aspects of social cognition and teamwork.<br>- Continued 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. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued research of human activity and intend recognition and dynamic biometrics for improved human system interfaces and force protection.<br>- Continued research into probabilistic reasoning in computation cognitive architectures.<br>- Continued research into computational social neuroscience to provide new models for manpower assignment and incentivization and new social models of cross-cultural interactions.<br>- Continued research on models of social dynamics and culture in small scale societies.<br>- Initiated research on brain-inspired intelligent systems to enable high-level interaction between warfighters and autonomous systems.<br>- Initiated research to explore the development of algorithms to automate assessment of the information value of Command and Control (C2) related data for next generation C2 systems.<br>- Initiated research to explore to dynamically provide decision support in support of rapid mission planning, re-planning and execution at command and combatant echelons. Research thrust to include dynamic mapping of decision space and decision-based, dynamic task allocation algorithms.<br>- Initiated research to explore concepts of operations for the management of information in hybrid autonomous systems.<br>- Initiated research on social neuroscience of Trust.<br>- Initiated research on data collection and processing for health surveillance and medical assistance. | | | |
| ***FY 2014 Plans:***<br>- Continue all efforts of FY 2013.<br>- Complete research into developing adaptive and individualized intelligent tutors for STEM training and education.<br>- Complete socio-culture research of complex humanitarian operations<br>- Initiate research on geography, health and disaster for next generation information systems for collaborative humanitarian assistance.<br>- Initiate research to improve collaborative systems and trust in computer mediated environments.<br>- Initiate socio-culture research of complex humanitarian operations.<br>- Initiate development of intelligent, embedded assessment for Intelligent Tutoring System (ITS).<br>- Initiate research on socially guided machine learning. This includes robotic teammates learning from human teachers both by demonstration and verbal instruction.<br>- Initiate the early exploration of modeling the cognitive basis for human moral judgments.<br>- Initiate research to explore the development of algorithms to automate assessment of the information value of Command and Control (C2) related data for next generation C2 systems.<br>- Initiate research to explore concepts of operations for the management of information in hybrid autonomous systems.<br>- Initiate research on geography, health and disaster for next generation information systems for collaborative humanitarian assistance.<br>- Initiate research to improve collaborative systems and trust in computer mediated environments. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate socio-culture research of complex humanitarian operations.<br>- Initiate research into cost effectively adapting current intelligent tutoring technologies to wider dissemination across Navy schoolhouses.<br>- Initiate/Complete socio-culture research of complex humanitarian operations.<br><br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Complete research of advanced biometrics such as biodynamic signatures to support spirals 2 and 3 of the Navy Identity Dominance System - Maritime Domain.<br>- Initiate research to address visualization and synthesis from multiple data sources to support autonomous systems and small hybrid teams.<br>- Initiate research on portable, intelligent, computer based expert decision aids for maintenance applications.<br>- Initiate research on computational models for predicting human error on procedural tasks.<br>- Initiate research on cognitive modeling for cybersecurity.<br>- Initiate research seeking a unified theory of the overall decision process, including the role of judgment with the goal that the unified theory will link currently existing, but isolated, conceptual theories of decision making, judgment, sensing, and detection.<br>- Initiate research into strategies for and utility of incorporating uncertainty into planning and asset allocation in Naval missions.<br>- Initiate research on human performance sources of cyber vulnerabilities of unmanned vehicle (UxV) systems.<br>- Initiate human systems integration research to reduce workload and increase operator situational awareness in command information center.<br>- Initiate research to understand and dynamically model context in operational decision making.<br>- Initiate research on statistical language translation for content analysis of threat behaviors and human security issues. | | | |
| ***Title:*** MATHEMATICS, COMPUTER, & INFORMATION SCIENCES | 42.915 | 48.305 | 36.726 |
| ***Description:*** Efforts include: Mathematical foundation and computational theory and tools for design, communication, and control of intelligent autonomous systems; theory, algorithms and tools for decision support; 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.<br><br>Accomplishments and plans described below are examples for each effort category.<br><br>Funding decrease in FY 2015 is the result of changing S&T investment priorities within the Department of the Navy.<br><br>***FY 2013 Accomplishments:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of mathematical optimization framework and heuristic algorithms that serve as theoretical and computational basis for network design, resource allocation, and logistics.<br>- Continued development of improved tactical and battlespace decision aids.<br>- Continued to refine techniques for extracting maximum knowledge from multi-modal imagery, text, and multisource signal data.<br>- 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.<br>- 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.<br>- Continued developing framework for dealing with effect of variable latencies in communication within teams of humans and autonomous systems.<br>- Continued efforts on quantum computing and cryptography.<br>- Continued efforts on model checking and automated theorem prover technologies.<br>- Continued efforts in mathematical modeling of complex physical phenomena.<br>- 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.<br>- 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.<br>- Continued development of mathematical, statistical, and computational framework leading to robust underlying approaches for automated information integration of disparate sources of data.<br>- Continued research in cognitive radio and networking protocols.<br>- Continued research on novel switched mode techniques to overcome radiation efficiency limit in electrically small antennas.<br>- Continued research in cross-layer wireless protocols for delay sensitive network traffic.<br>- Continued multidisciplinary research efforts to focus on intelligent control systems, cooperative behavior modeling and response,UxV-human interactions and adaptive mission methodologies.<br>- Continued development of an interaction model of how users characterize visual content and context to improve video surveillance.<br>- Continued development of improved formal foundations, methods, and tools for compositional verification and construction of high assurance software systems.<br>- Continued investigation of relational constructive induction, semi-supervised learning, and classifier ensembles to improve collective classification technology and operations based automated decision aids.- Completed efforts on Ferrite-based broadband circulators.<br>- Continued 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.<br>- Continued research into anti-tamper and information assurance: research focused on protection techniques, architectures, | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| algorithms, protocols that allow for security and cyber situational awareness.<br>- Continued research to develop mathematical and computational tools for compressive sensing.<br>- Continued the development of theory and algorithms for quantum communications.<br>- Continued efforts on Ferrite-based broadband circulators.<br>- Continued efforts addressing the representation, computation, and analysis of information from large diverse data sets.<br>- Continued research efforts to develop tools for proactive information assurance and cyber space security.<br>- Continued multidisciplinary research efforts on reasoning for image understanding in uncertain environments.<br>- Continued multidisciplinary research efforts to provide information assurance foundations for countering the Botnet threats.<br>- Continued research efforts addressing computational complexity arising from network-enabled computing, such as cyber security, information integration, and intelligent autonomy of networked, cooperative systems.<br>- Continued research efforts to develop methods and algorithms for computing with natural language.<br>- Continued mathematical studies to understand the micro-physics of a liquid-solid-gas interaction in turbulent flow conditions.<br>- Continued research efforts for mathematical development of physics-based computational and signal processing techniques for understanding and characterizing biological-acoustical coupling in acoustic wave propagation and scattering.<br>- Continued effort to improve tactical networks by developing a theoretical performance model for wireless networks.<br>- Continued effort to optimize quantum communication bandwidth in noisy environments by developing a new mathematical representation of quantum information.<br>- Initiated research on mathematical and computational building blocks for machine reasoning and intelligence.<br>- Initiated multidisciplinary research efforts on knowledge representation and reasoning for decentralized autonomy.<br>- Initiated research efforts on algorithmic solutions and explicit measurement schemes for networks inference and monitoring.<br>- Initiated research on novel techniques for interference mitigation.<br>- Initiated efforts to develop computer sciences foundation for quantum information sciences leading to new ways of computing and communication.<br>- Initiated research to improve teleoperation of robotic manipulators by developing a system trained by a human operator to perform complex manipulation tasks.<br>- Initiated research to develop a theory of trust-based traffic security by creating models of trust, network structure and dynamics, and incentives and economics.<br>- Initiated research to develop the foundation for new techniques that enable the adaptive characterization of evolving computer network traffic patterns. | | | |
| ***FY 2014 Plans:***<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Initiate research on distributed network synchronization. | | | |
| ***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete research on novel switched mode techniques to overcome radiation efficiency limit in electrically small antennas. | | | |
| ***Title:*** MATERIALS/PROCESSES | 57.975 | 57.403 | 55.675 |
| ***Description:*** 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.<br><br>Accomplishments and plans described below are examples for each effort category.<br><br>Funding decrease in FY 2015 is the result of changing S&T investment priorities within the Department of the Navy.<br><br>***FY 2013 Accomplishments:***<br>Structural Materials<br>- Continued development of first-principles based methodologies for predicting the thermodynamics and kinetics controlling microstructural evolution for the design of advanced weldable, naval steels.<br>- Continued development of models and simulations to understand and predict high deformation rate blast behavior for engineered topological structures.<br>- Continued development of materials and fabrication science for fugitive phase processes for engineered topological structures for ship blast protection.<br>- Continued quantification of the corrosion effects on fatigue to be incorporated into the Unified Damage Model and validated in a few environmental cases on P-3 aircraft real loads data.<br>- Continued developing carbon nanotubes growth and mechanical behavior in advanced composites for next generation ship and aircraft structures.<br>- Continued development of theoretical basis for composite materials behavior based on x-ray computed microtomography.<br>- Continued development of understanding and constitutive models of dynamic behavior of naval steels.<br>- Continued evaluating environmental effects on marine composites and sandwich structures.<br>- Continued exploration of composition, processing and microstructural evolution in titanium alloys for marine structures.<br>- Continued exploration of multienergy processes for zero maintenance coatings.<br>- Continued investigation of a rapid annealing of surface layers and their effects.<br>- 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.<br>- 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. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued to investigate the use of photorefractive crystals for the demodulation of a distributed fiber optic Bragg gratings structural health monitoring system.<br>- Continued 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.<br>- Continued efforts to understand and predict salt chemistry effects on high temperature coatings and materials in naval gas turbine environments.<br>- Continued understanding for development of modeling tools for enhancing dynamic response and projectile resistance for sandwich structures.<br>- Continued the fatigue life prediction model analysis on high temperature engine materials.<br>- Continued development of new methods for room temperature curing and processing of polymer composites with high temperature thermoxidative stability and fire resistance.<br>- Continued assessment of the blast resistance of cellular structures as functions of soil characteristics.<br>- Continued materials and fabrication science for fugitive phase processes for engineered topological structures for vehicle blast and fragmentation protection.<br>- Continued exploration of fundamental mechanisms and initiate development of physics-based models of electrophoretic deposition of ceramic nanoparticles and subsequent sintering.<br>- Continued physics based models for coupled phenomena in marine composite structures (thermo-mechanical loads, environmental effects, and fluid-structure interactions.)<br>- Continued Computer-Aided Materials Design (CAMD) for synthesis and testing of various materials.<br>- Continued structure and properties of liquid and glassy metals.<br>- Continued scientific basis for the rational engineering design of Al-alloys for Naval applications.<br>- Completed high temperature, low frictional sliding coefficient materials for elevated operating temperature gas turbine engine bearings.<br>- Initiated establishment of mechanics of crack propagation in aluminum structures, and explore concepts for enhancing fracture resistance.<br>- Initiated development of refractory solid metal carbide composites from metal / polymer precursors.<br><br>Functional Materials<br>- Continued research tools design efforts in electromagnetic and acoustic bandgap materials.<br>- Continued study of new transduction mechanisms.<br>- Continued development of the science and technology base for a highly efficient and stable flexible organic solar cell.<br>- 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.<br>- Continued effort to synthesize beta-SiC power suitable for subsequent densification into transparent beta-SiC ceramic. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued meta-materials effort to develop negative index materials with dynamic frequency response.<br>- Continued synthesis and property measurement of new sonar materials predicted by first principle methods.<br>- Continued expansion of first-principles methods devised to calculate piezoelectric properties of materials for sonar transducers to calculate additional materials properties for other applications.<br>- Continued 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.<br>- Continued basic research into material technology associated with the development of active and conventional armor.<br>- Continued effort to characterize regenerative bacterial nanowires.<br>- Continued effort to synthesize cyclic peptide ring modules and polymerize them into peptide nanotube polymers.<br>- Continued efforts to utilize chemically modified virus proteins as a scaffold to assemble nanostructured metamaterials with unique optical properties including negative index of refraction.<br>- Continued effort to develop surface electrons on diamond.<br>- Continued efforts to develop oxide materials for power management, sensors, and information storage/processing.<br>- Continued effort to use elastic pentamode metafluid materials for acoustic cloaking.<br>- Continued effort to characterize the properties of chemically reactive flows subject to non-Kolmogorov or non-equilibrium turbulence, or that create these types of turbulence.<br>- Continued effort to develop conjugation strategies that can allow the efficient attachment of multiple biological moieties to nanoparticles (NPs) in a controlled manner.<br>- Continued examination of the effects of acoustic perturbations and interactions in reacting flows and determine how they can be used.<br>- Completed effort to develop conjugation strategies that can allow the efficient attachment of multiple biological moieties to nanoparticles (NPs) in a controlled manner.<br>- Initiated exploratory synthesis, electromechanical property evaluation and atomic level analysis of new quaternary piezocrystals in order to optimize materials properties for specific Navy SONAR applications.<br>- Initiated development of advanced nanostructured magnetic materials for energy applications.<br>- Initiated development of cladded single crystal fibers.<br><br>Counter-IEDs<br>- Initiated study of biomimetic nano composites.<br>- Initiated study of energy transduction through soft armor.<br><br>Sensors, Electronics & EW<br>- Completed an effort to establish the physicochemical nature giving rise to the anomalously high electron conductivity of single-unit-layer conductive skins of RuO2 used to coat a wide array of dielectric substrates.<br>- Completed research into novel super resolution algorithms using optical flow techniques. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Completed investigation of mathematical solutions and algorithms for resolving issues with sparse sensing radar.<br>- Completed effort to demonstrate and develop one dimensional spin transport & manipulation in Si and Ge nanowires and to develop new lateral growth method for Ge NWs on Si(001).<br>- Initiated study of active control of biomolecular binding on surfaces.<br>- Initiated search for sustainable replacements for semiconductors and strong magnets.<br>- Initiated study of sensing, selection and control of marine microbes.<br>- Initiated effort to develop techniques for the atomic layer deposition of high-quality dielectric films on semiconductor surfaces with extremely low interface state densities.<br>- Initiated effort to determine the feasibility and develop a greater understanding of defect science in SiC epitaxial layers on low offcut substrates suitable for power electronic applications.<br>- Initiated fundamental investigation onto the synthesis and material properties of graphene, boron nitride and other two dimensional materials; identify potential exploitation avenues.<br>- Initiated development of the method of moments solvers for millimeter wave region<br>targets<br>- Initiated development of phase-only pattern synthesis for transmit arrays.<br>- Initiated development of a new theory of inference for statistical signal processing.<br><br>Maintenance Reduction<br>- Continued development of corrosion models.<br>- Continued mechanistic studies of materials deterioration under chemical environment for ship materials and their interfaces.<br>- Continued stainless steel carburization study to enhance corrosion performance.<br>- Continued the concept study of multiscale corrosion modeling on naval ship materials.<br>- Continued fundamental theoretical and experimental studies on nanoscale corrosion of metals and alloys.<br>- Continued corrosion prediction using an integrated deterministic-based model.<br>- Continued grain boundary engineering to improve corrosion resistance of marine grade aluminum alloys.<br>- Continued modeling and simulation of corrosion phenomena.<br>- Continued studies of surface microstructure optimization to enhance corrosion properties of navy marine alloys<br>- Continued sensor development for monitoring microstructural changes on alloys under thermal and mechanical stresses.<br>- Continued research focused on modeling and simulation for platform and system affordability, lifetime materials, shipboard wireless capability, automation to reduce manning.<br>- Continued development of ab initio models of corrosion reactions.<br>- Continued development of coatings capable of actively responding to environmental stresses.<br>- Continued study of coating failure mechanism on coating-substrate interface.<br>- Continued research on innovative concepts for effective radiation barrier coatings and ultra-low thermal conductivity barrier coatings. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of environmental corrosivity modeling.<br>- Continued development of nanoscale modeling of corrosion kinetics.<br>- Continued development of surface tolerant coatings.<br><br>Environmental Science<br>- Continued examination of scientific methods for pollution prevention, waste reduction, and hazardous material reduction for Naval Operations.<br>- 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.<br>- Continued effort to determine most promising foul-release approaches based on silicones to meet Navy durability requirements.<br>- Continued effort to develop Reverse Osmosis (RO) pre-treatment strategies to allow water recycling on ships.<br>- Continued efforts on treatment strategies of oily water containing synthetic lubricants.<br><br>Manufacturing Science<br>- Continued a multidisciplinary research task into furthering the sciences associated with advances in manufacturing processes. | | | |
| ***FY 2014 Plans:***<br>Structural Materials<br>- Continue all efforts of FY 2013, less those noted as completed above.<br><br>Functional Materials<br>- Continue all efforts of FY 2013, less those noted as completed above.<br><br>Maintenance Reduction<br>- Continue all efforts of FY 2013, less those noted as completed above.<br><br>Environmental Science<br>- Continue all efforts of FY 2013, less those noted as completed above.<br><br>Manufacturing Science<br>- Continue all efforts of FY 2013, less those noted as completed above. | | | |
| ***FY 2015 Plans:***<br>Structural Materials<br>- Continue all efforts of FY 2014, less those noted as completed above. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete first-principles based methodologies for predicting the thermodynamics and kinetics controlling microstructural evolution for the design of advanced weldable, naval steels.<br>- Complete scientific basis for the rational engineering design of Al-alloys for Naval applications.<br>- Complete exploration of multienergy processes for zero maintenance coatings.<br><br>Functional Materials<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Complete study of new transduction mechanisms.<br><br>Maintenance Reduction<br>- Continue all efforts of FY 2014, less those noted as completed above.<br><br>Environmental Science<br>- Continue all efforts of FY 2014, less those noted as completed above.<br><br>Manufacturing Science<br>- Continue all efforts of FY 2014, less those noted as completed above. | | | |
| ***Title:*** MEDICAL/BIOLOGY | 18.863 | 20.611 | 18.225 |
| ***Description:*** Efforts include: Bioinspired autonomous and surveillance systems, and bio-inspired processes, materials and sensors; synthetic biology for Naval applications; casualty care and management; casualty prevention; undersea medicine/ hyperbaric physiology; biorobotics; expeditionary operations training; stress physiology and regenerative medicine. These efforts are coordinated with the Army and Air Force through joint program reviews and meetings and are complementary, not duplicative.<br><br>Accomplishments and plans described below are examples for each effort category.<br><br>Funding decrease in FY 2015 is the result of changing S&T investment priorities within the Department of the Navy.<br><br>***FY 2013 Accomplishments:***<br>Medical Sciences<br>- Continued work on stress physiology, hyperbaric physiology, and biological effects of Naval operational exposures.<br>- Continued work in understanding the mechanisms of decompression illness and hyperbaric oxygen toxicity.<br>- 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. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued research to explore systematic relationships between cognitive and physiological responses to laboratory tasks under operational conditions.<br>- Continued research to explore mechanisms of "ultrasonic" hearing in divers.<br>- Continued research to explore a novel opioid that will produce analgesia as effective as morphine, with minimal side effects.<br>- Continued interventions to mitigate underwater sound/blast effects.<br>- Continued research on improved trauma management in submarine Special Forces operators.<br>- Continued research on physiological and genetic effects of long-term diving.<br>- Continued research in genetic basis of psychological stress.<br>- Continued research in mitigation of the effects of sleep deprivation.<br>- Continued research in stress effects on the immune system.<br>- Continued research with Army, in regenerative medicine (Armed Forces Institute for Regenerative Medicine (AFIRM)<br>- Continued research to discriminate fatigue and stress performance effects.<br>- Continued research on individual susceptibilities in extreme environments to include hypoxic and/or hypobaric conditions.<br>- Initiated research to evaluate the effects of chronic stress on performance.<br>- Initiated research to assess the effects of hyperbaric oxygen therapy on blast-induced histopathological changes.<br><br>Biological Sciences<br>- Continued efforts focused on microbe-materials interfacial interactions for detection of materials defects/failures, including corrosion, and for improved energy harvesting.<br>- Continued efforts in "smart cell engineering" to design microbes that can sense and destroy other microbes through antibioticproduction, or can "sense" and qualify their surrounding environment and provide information back to the user.<br>- Continued combinatorial chemical screens for bacterial communication pathway inhibitors as potential antibiotics or fouling control agents.ontinued research on biofouling with emphasis on barnacle adhesion studies using molecular biology tools.<br>- Continued research on invertebrate larval settlement and metamorphosis in response to biofilms and various inhibitors of adhesion.<br>- Continued 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.<br>- Continued efforts to identify molecular biomarkers for battlefield injuries, and high-fidelity biosensors for detection in vivo.<br>- Continued research into biomolecular 'logic controllers' for in vivo biosensor and in vivo drug delivery systems.<br>- Continued research efforts focused on developing bio-inspired sensors, vehicles and systems for local Intelligence, Surveillance and Reconnaissance (ISR), Weapons of Mass Destruction (WMD) detection, personnel protection and affordability. Research elements include advances in microfabrication, biological materials, processing techniques, robustness and efficiency of systems.<br>- Continued research on stem cells in marine mammals and their potential clinical role.<br>- Continued development of a second set of molecular diagnostic tests for recently discovered viral pathogens of marine mammals. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued research in elucidation of mechanisms of fish electric sense and near field low frequency acoustic perception.<br>- Continued research on bacterial/cellular controllers for nano/micro-systems<br>- Continued efforts to investigate DNA-scaffold-directed assembly of protein nanoarrays for control over orientation and position of proteins, and investigate triggered isothermal assembly of DNA nanostructures.<br>- Continued efforts in comparing commensal/pathogenic microbiomes in to Atlantic bottlenose dolphin and California sea lion, and for the dolphin diagnosed with chronic/active gastritis.<br>- Initiated synthetic biology efforts for designing organisms with non-natural functions (e.g., light detection, electrical 'switch' capability, magnetic field production)<br>- Initiated research to identify natural product inhibitors of bacterial folate biosynthesis for development as antibiotics.<br>- Initiated studies to control the synthesis of patterned materials from the nano-scale to the micro-scale using bionanotechnology. | | | |
| ***FY 2014 Plans:***<br>Medical Sciences<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Initiate research on individual susceptibilities on health and human performance in military environments to include heat, cold, enclosed spaces, pressure and acceleration.<br>- Initiate research on the mechanisms of nitrogen narcosis/high pressure nervous syndrome<br>- Initiate investigations of mechanisms of blast-induced neurotrauma at the cellular level.<br><br>Biological Sciences<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Complete development of a second set of molecular diagnostic tests for recently discovered viral pathogens of marine mammals.<br>- Initiate research on characterizing/manipulating human gut microbiome to understand its role in response to behavioral and physical stressors.<br>- Initiate development of new tools and techniques for the engineering and characterization of DNA nanostructures and the control of DNA-based nanodevices.<br>- Initiate the investigation of the material properties of silk proteins in order to facilitate development of applications.<br>- Initiate development of field portable sensing platforms for explosives detection. | | | |
| ***FY 2015 Plans:***<br>Medical Sciences<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Initiate research in partnership with the Army to study regenerative medicine (Armed Forces Institute for Regenerative Medicine II (AFIRM II)).<br>- Initiate research to investigate novel mechanisms to manage the mammalian circadian system for optimized health and performance. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate research to develop strategies for nerve cell regeneration.<br><br>Biological Sciences<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Initiate research on tubeworm adhesion science using molecular biology tools. | | | |
| ***Title:*** OCEAN SCIENCES | 79.043 | 89.619 | 79.351 |
| ***Description:*** 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.<br><br>Accomplishments and plans described below are examples for each effort category.<br><br>Increase in Ocean Sciences from FY 2013 to FY 2014 is due to support at-sea, ocean science research and ship time in western Pacific, Indian, and Arctic Oceans.<br><br>Funding decline in Ocean Sciences from FY 2014 to FY 2015 is the result of reduced investment in Basic Research within the Department of Defense.<br><br>***FY 2013 Accomplishments:***<br>Littoral Geosciences and Optics<br>- 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.<br>- Continued efforts to investigate the effects of oceanic biota on the propagation and inversion of multifrequency acoustical energy.<br>- Continued investigations of sources and properties of light scatter within the coastal ocean.<br>- Continued to investigate the physical processes that control re-suspension of bottom sediments and the resulting impact on optical and acoustical propagation.<br>- Continued investigations of oceanic processes within the surface boundary layer that control high-frequency variability in image propagation and distortion.<br>- Continued to investigate and characterize the impact of riverine sources of optically-important matter on underwater visibility,navigation, and surveillance.<br>- Continued field program to infer sea floor characteristics from observations of surface gravity waves.<br>- Continued effort to understand the extent and intensity of seafloor gas hydrate accumulations and coastal bio-optical response to air-ocean forcing. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued programs to estimate optical properties of coastal ocean water from above-surface sensing, using in situ data for validation.<br>- Continued studies to predict tidal flat evolution in coastal/riverine/estuarine systems.<br>- 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.<br>- Continued development of prediction models for distributaries deltaic coastal environments.<br>- Continued studies of tidal flat evolution in wave dominated environments.<br>- Continued studies of dissipation of surface gravity waves by muddy seabed sediments.<br>- Continued field, modeling and remote sensing studies of currents, waves, sediment transport and bathymetric evolution of river mouth and inlet environments.<br>- Continued investigations of radar, hyperspectral and electro-optical remote sensing signatures in littoral environments.<br>- Initiated development of a new method of data assimilation, adjointless 4D-Var through a combination of theoretical analysis and numerical simulations to develop the method and estimate its efficiency with respect to the traditional 4d-VAR scheme as well as to use it to generate a sensitivity analysis for targeted observations<br>- Initiated the effort to identify and isolate the dynamical processes that control the structure and variability of the Kuroshio and Ryukyu Current using a combination of numerical model simulations and observations and, explore their interactions between the Ryukyu Island passages.<br>- Initiated the development of a numerical model system (composite of new and existing process models and data bases) and compare with observations, as well as use it to simulate future scenarios to quantify importance of seafloor carbon to the global carbon cycle now, and in the future.<br><br>Marine Mammals and Biology<br>- 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.<br>- Continued new efforts on tracking of marine mammals using data fusion based on tags and remote sensing.<br>- Continued new efforts to examine physiology of marine mammals in situ and to predict consequences of physiological and auditory stress to populations.<br><br>Physical Oceanography and Prediction<br>- Continued field studies/modeling to predict propagation and effect on acoustics of non-linear internal waves in the western Pacific.<br>- 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.<br>- Continued design evaluation for a persistent mobile sampling network based on autonomous undersea vehicle platform and | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| sensor technologies.<br>- Continued field programs that demonstrate persistent monitoring and measurement of environmental structures using gliders.<br>- Continued workshops to define science needs for Sea Basing.<br>- 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.<br>- Continued an Estuarine-Littoral Processes Interaction field study in muddy and tidal flat dominated regimes including a data assimilative prediction capability.<br>- Continued studies of complex ocean currents in the Indian Ocean using gliders and remote sensing methods being developed to support tactical oceanography.<br>- Continued studies of internal waves and strait dynamics emphasizing field studies in the Celebes, Philippine, and Sulu Seas.<br>- Continued studies to understand how to sample ocean processes with gliders and other autonomous and remote sensing systems to support tactical oceanography.<br>- 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.<br>- Continued development of expert system methods to characterize and predict Riverine/estuarine systems to support Naval Special Warfare, Marine Expeditionary Forces and new Riverine units.<br>- Continued studies of complex ocean currents in the Indian Ocean using gliders and remote sensing methods being developed to support tactical oceanography.<br>- Continued studies of ocean and wave response to typhoons and monsoons in the Western Pacific.<br>- Continued 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.<br>- Continued extensive 3-year field program on prediction of internal waves.<br>- Continued extensive internal wave field program off the New Jersey Shelf; field work will coincide with and complement the Shallow Water Acoustics program.<br>- Continued an assessment of the role of emerging sub-mesoscale parameterization techniques for improving next generation high resolution/high accuracy environmental models.<br>- Continued studies of complex ocean currents in the Indian Ocean using gliders and remote sensing methods being developed to support tactical oceanography.<br>- Continued the field and modeling experiments to determine the lateral dispersion and maxing parameterization needed to understand model turbulence and to model ocean circulation.<br>- Continued an effort to understand the ageostrophic vorticity dynamics of the ocean with an emphasis on the processes leading to the generation of submesoscale variability and coastal frontogenesis.<br>- Continued an effort to understand the dynamics that govern spiciness variability, its impact on ocean circulation, and the competing roles temperature and salinity have on ocean density and sound speed structure evolution. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued a field and modeling effort to understand and predict the generation and variability of western boundary currents in the Pacific Ocean.<br>- Continued a field and modeling effort to understand the coupled physical processes that result in the propagation of the air-sea mode known as the Madden-Julian Oscillation in the Indian Ocean.<br>- Continued a field and modeling program to investigate the structure and circulation of the South China Sea and oceanographic variability along the coast of Vietnam.<br>- Continued studies of the coupled atmosphere-ocean-cryosphere-wave physics from the submesoscale to decadal climate scales to permit development of new global coupled modeling systems.<br>- Continued studies of changes in the Arctic oceanography, meteorology and cryosphere and associated processes to allow permit development of new prediction models for the Arctic.<br>- Continued arctic research to develop a new generation of ocean-ice-atmosphere dynamic prediction models, including process studies involving remote sensing and in-situ observations.<br>- Completed an effort to understand the ageostrophic vorticity dynamics of the ocean with an emphasis on the processes leading to the generation of submesoscale variability and coastal frontogenesis.<br>- Completed extensive 3-year field program on prediction of internal waves.<br>- Completed extensive internal wave field program off the New Jersey Shelf; field work will coincide with and complement the Shallow Water Acoustics Program.<br>- Completed workshops to define science needs for Sea Basing.<br>- Completed an Estuarine-Littoral Processes Interaction field study in muddy and tidal flat dominated regimes including a data assimilative prediction capability.<br>- Completed an assessment of the role of emerging sub-mesoscale parameterization techniques for improving next generation high resolution/high accuracy environmental models.<br>- Initiated collaborative studies with Vietnam to observe and model oceanographic processes along the Vietnamese shelf.<br>- Initiated field experiments using autonomous vehicles to observe topographically-generated currents and turbulence around islands in the Western Pacific Ocean.<br>- Initiated research efforts related to the development of an Earth System Prediction Capability to enable improvements in extended range environmental forecasts.<br><br>Ocean Acoustics<br>- 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.<br>- Continued a field and modeling effort to simultaneously study shallow-water medium fluctuations and develop time-reversal communications using adaptive channel equalizers.<br>- Continued analysis and modeling to understand the physics of buried mine detection through broadband and synthetic aperture sonar. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - 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.<br>- Continued a field and modeling effort to establish the capabilities of underwater acoustic communications for FORCEnet and persistent undersea surveillance.<br>- Continued the development and testing of geo-acoustic inversion and extrapolation methods.<br>- Continued investigations into quantifying, predicting and exploiting uncertainty in acoustic prediction models.<br>- 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.<br>- 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.<br>- Continued effort to understand synoptic scale ocean variability in the strategic Turkish Straits System including water mass exchange between basins and vertical mixing.<br>- Continued data collection and analysis of deep water ambient noise with emphasis on the Philippine Sea.<br>- Continued reverberation and clutter modeling studies.<br>- Continued investigation of acoustic propagation in the Arctic. | | | |
| ***FY 2014 Plans:***<br>Littoral Geosciences and Optics<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Complete studies of tidal flat evolution in wave dominated environments.<br>- Complete studies of dissipation of surface gravity waves by muddy seabed sediments.<br>- Complete 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.<br>- Complete investigations of the physical processes that control re-suspension of bottom sediments and the resulting impact on optical and acoustical propagation.<br>- Complete field program to infer sea floor characteristics from observations of surface gravity waves.<br>- Complete investigations of oceanic processes within the surface boundary layer that control high-frequency variability in image propagation and distortion.<br>- Initiate studies of Coupled Human-Landscape Interactions in Low-lying Coastal Environments.<br>- Initiate studies of data-assimilative modeling for coupled nearshore-riverine systems.<br><br>Marine Mammals and Biology<br>- Continue all efforts of FY 2013, less those noted as completed above. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Physical Oceanography and Prediction<br>- Continue all efforts of FY 2013, less those noted as completed above.<br><br>Ocean Acoustics<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Complete analysis and modeling to understand the physics of buried mine detection through broadband and synthetic aperture sonar.<br>- Complete effort to understand synoptic scale ocean variability in the strategic Turkish Straits System including water mass exchange between basins and vertical mixing.<br>- Initiate soft sediment geoacoustic inversion studies with an emphasis on the Gulf of Mexico.<br>***FY 2015 Plans:***<br>Littoral Geosciences and Optics<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Initiate research efforts to observe, understand, and predict the many intertwined geophysical processes which are present on the inner shelf.<br><br>Marine Mammals and Biology<br>- Continue all efforts of FY 2014, less those noted as completed above.<br><br>Physical Oceanography and Prediction<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Initiate research efforts to observe, understand, and predict the evolution of the Marginal Ice Zone in the Arctic Ocean.<br>- Initiate in situ, airborne, and remote sensing observational efforts to inform scientific studies of the physical environment in the Arctic region.<br>- Initiate research on integrated Arctic System Models to enable improved forecasts of the operational environment on lead times from hours to months in the Arctic domain.<br>- Initiate an investigation into the changing surface conditions of the Arctic Ocean, resulting from observed reductions in sea ice cover.<br><br>Ocean Acoustics<br>- Continue all efforts of FY 2014, less those noted as completed above. | | | |
| ***Title:*** SCIENCE AND ENGINEERING EDUCATION, CAREER DEVELOPMENT AND OUTREACH | 33.190 | 42.587 | 47.252 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

***Description:*** 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. It is centered around Naval S&T efforts supporting Science, Technology, Engineering and Math (STEM). Outreach includes the encouragement, promotion, planning, coordination and administration of Naval Science and Technology. It also includes international scientific exploration through ONR Global.

The funding increases in FY 2013 thru FY 2015 are the results of significant emphasis on the Science, Technology, Engineering and Mathematics (STEM) initiative.

***FY 2013 Accomplishments:***
Science, Technology, Engineering and Math (STEM)
- Continued awarding prizes at 400 regional high school science fairs and four national competitions For Inspiration and Recognition of Science and Technology (FIRST), Junior Science and Humanities Symposia (JSHS), and Association for Unmanned Vehicle Systems International (AUVSI).
- Continued supporting high school summer interns at Navy laboratories Science and Engineering Apprentice Program (SEAP).
- Continued supporting undergraduate/graduate students as summer research interns at Navy laboratories Naval Research Enterprise Internship Program (NREIP).
- Continued providing graduate fellowship support to HBCU engineering faculty candidates.
- Continued funding Young Investigator Program (YIP) research grants.
- Continued inspiring, engaging, educating and employing exceptional candidates to sustain and enhance the naval research enterprise.
- Continued funding for the following educational and outreach efforts: Youth Exploring Science (YES), American Society of Materials (ASM) Teacher Camp, Expanding Your Horizon (EYH), Forest Partners, and Sally Ride Science, plus SeaPerch, FIRST,and BotBall robotics efforts.
- Continued support for SciGirls, Navy GEMS (Gains in the Education of Mathematics and Science), STEM Literacy for Navy recruits, Business-Higher Education Forum (BHEF), and the Gulf Coast Initiative.
- Initiated new projects to further teacher development and Grades 13/14 STEM degree retention.

International Outreach - ONR Global
- Continued international outreach support through ONR Global that provides a conduit for new scientific areas on the international front and promotes foreign sources of research important to the Naval mission. (ONRG)

***FY 2014 Plans:***
Science, Technology, Engineering and Math (STEM)

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts of FY 2013.<br>- Initiate new effort on undergraduate retention in STEM majors at Minority Serving Institutions.<br>- Initiate new effort for teacher training in STEM for schools in underserved communities.<br>- Initiate new computer science programs for female undergraduates.<br>- Initiated expansion of internships to underserved students.<br>- Initiate Masters in Systems Engineering program at a minority institution in partnership with Assistant Secretary of the Navy (Research, Development and Acquisition).<br><br>International Outreach - ONR Global<br>- Continue all efforts of FY 2013.<br><br>***FY 2015 Plans:***<br>Science, Technology, Engineering and Math (STEM)<br>- Continue all efforts of FY 2014.<br><br>International Outreach - ONR Global<br>- Continue all efforts of FY 2014.<br>The ONRG International Science Program mission is to search the globe for emerging scientific research and advanced technologies to enable the Office of Naval Research and the Naval Research Enterprise to effectively address current needs of the Fleet/Forces, and investigate and assess revolutionary, high-payoff technologies for future naval missions and capabilities. This is accomplished through PHD-level Associate Director scientists located in Asia, Europe and South America collaborating with international organizations and researchers through grants in innovative basic research, and establishing quality, relevant connections between international science and technology (S&T) centers of excellence and DON, DOD, and other US Government organizations. The direct impact of this investment is to capitalize on international basic research during unprecedented and dynamic global interdependence, increasing the ability to solve DON S&T challenges through shared knowledge and technologies with partners during a time of budget constraints. Additionally, this investment builds global S&T awareness to reduce the risk of potential technological surprise, and supports theater security cooperation goals to sustain cooperative relationships with an expanding set of international partners to enhance global security. | | | |
| ***Title:*** SENSORS, ELECTRONICS AND ELECTRONIC WARFARE (EW) | 44.644 | 54.180 | 54.875 |
| ***Description:*** Efforts include the basic research portions of: Sensing, diagnostics, and detectors; navigation and timekeeping; nanoelectronics; 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 (InTop) Innovative Naval Prototype (INP); and RF electronic warfare. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

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

The increase from FY 2013 to FY 2014 is due to increased research emphasis in Anti-Submarine Warfare Distributed Search, Functional Materials, Electro-Optical/Infra-Red sciences.

FY 2015 funding decrease within the SEEW efforts conducted at the Naval Research Laboratory.

***FY 2013 Accomplishments:***
- Continued monolithic integration of multifunctional materials to enable passive devices and sensors into wide bandgap semiconductor circuits.
- Continued investigation of physical basis for improved time and frequency standards using quantum-entangled ions and atoms.
- Continued investigation of ultra high speed logic and multiple-quantum-well devices with a goal of >500 gigahertz (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 terahertz (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.
- 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 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 a program to apply innovative mass nanofabrication techniques to previously developed nanodevice arrays.
- Continued a program on the control of deleterious defects in silicon carbide (SiC).
- Continued a program on the study of Quantum Dots and their application to coherent wave function control and quantum information.
- Continued a program on the tailoring of the optical, structural and electronic properties of semiconductor quantum wires.
- Continued 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.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued 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.<br>- Continued 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.<br>- Continued demonstrations of tunable analog filters made in a digital Nb device foundry.<br>- Continued development of techniques to observe directly the electrical properties of pair states in high temperature superconductors.<br>- Continued work on optical manipulation of ultra-cold atoms.<br>- 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.<br>- Continued the evaluation and assessment of hardware-compatible space-time algorithms for Digital Signal Processor (DSP)applications to Transmit/Receive (T/R) arrays.<br>- Continued 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.<br>- Continued project to explore graphene based nanoelectronic devices.<br>- Continued program in chip-scale quantum architectures.<br>- Continued project to reduce heat transfer through electrical leads in cryogenic packaging.<br>- Continued 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.<br>- Continued high-sensitivity magnetometry using quantum logic.<br>- Continued materials studies of low temperature regenerator (high thermal capacity) materials and/or controlled flow microstructures with the goal of improving energy efficiency of cryocoolers.<br>- Continued research into fundamental concepts and mathematics for digital array architectures.<br>- Continued research to apply carbon nano-tube technology to acoustic sensing.<br>- Continued research to investigate two-dimensional electron gases in perovskite oxide heterostructures.<br>- Continued project to investigate self-assembled one-dimensional GaN channels in AlGaN/GaN structures.<br>- Continued spin-based electronics research.<br>- Continued graphene physics and bandgap engineering research.<br>- Continued semiconducting nanowire synthesis and characterization research.<br>- Continued research on strain engineering in graphene.<br>- Continued work on spin properties of graphene.<br>- Continued research on focused electron beam based angstrom-scale nano-patterning.<br>- Continued research effort to determine the most appropriate tunnel barrier for MgB2 Josephson junctions. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued an effort to grow low defect density, high purity epitaxial 4H-SiC at high growth rates suitable for high power electronic device applications.<br>- Continued design, construction, and testing of sonic crystals that can be tuned to have specific acoustic properties.<br>- Continued effort to create a physics-based understanding of epitaxial oxides and insulators for use in applications for advanced electronics.<br>- Continued investigation into stabilizing in-phase coherent state of coupled systems for coherent power generation.<br>- Continued high output impedance solid state device technologies and materials.<br>- Continued effort to fabricate functionalized micro-opto-mechanical systems for the measurement of micromechanical photothermal spectra of adsorbed chemical vapor analytes.<br>- Continued research effort on chemical synthesis and bandgap tailoring in graphene nanoribbons.<br>- Continued research on spin dynamics in Group IV semiconductors and related device concepts.<br>- Continued research efforts on non-conventional nanofabrication that hold promise for sub-10nm resolution.<br>- Continued 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.<br>- Continued studies of the generation and recombination dynamics of non-equilibrium quasiparticles associated with digital switching events in superconducting logic.<br>- Continued investigation of metamaterials with embedded active devices to better understand multidimensional signal processing from RF through THz frequencies.<br>- Continued effort on nuclear optical frequency standard in thorium 229.<br>- Continued studies of intraband transitions in wide bandgap quantum wells.<br>- Continued studies of the use of non-linear optical (phonon-photon interactions) phenomena as a method of cooling to cryogenic temperatures.<br>- Continued effort to investigate statistical representations of target and signal techniques.<br>- Continued studies of chemical vapor deposition (CVD) of graphene on copper.<br>- Continued research on duel-STM characterization of graphene film.<br>- Continued research on defect engineering and characterization in graphene.<br>- Continued studies of how to prevent flux trapping and diagnose its occurrence in complex superconducting circuits and to design real time expert measurement systems in general for testing of new designs defined in VHSIC (Very High Speed Integrated Circuits) Hardware Description Language (VHDL).<br>- Continued MgB2 Josephson junction work with first tests of 10 device logic cells to determine likely clock speeds of this new materials technology.<br>- Continued demonstrations of tunable analog filters made in a digital Nb device foundry.<br>- Continued high output impedance solid state amplifier technologies.<br>- Continued program of ultraprecise gravitational measurements using atom interferometers.<br>- Continued research on graphene based high performance flexible electronics. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued research on DNA based carbon nanotube sorting and placement.<br>- Continued investigation of electrical stress characterization and Gallium Nitride transistor stability.<br>- Continued development of a path-integral-based theory of wave propagation in bounded, disordered media.<br>- Continued research effort to provide a fundamental understanding of spin transport, scattering and manipulation in the Group IV semiconductors necessary for future technological development of spin as an alternate state variable.<br>- Continued an effort to establish the physicochemical nature giving rise to the anomalously high electron conductivity of singleunitlayer conductive skins of RuO2 used to coat a wide array of dielectric substrates.<br>- Continued research into novel super resolution algorithms using optical flow techniques.<br>- Continued investigation of mathematical solutions and algorithms for resolving issues with sparse sensing radar.<br>- Continued effort to develop multiple layered semiconductor quantum dots for infrared optical applications.<br>- Continued effort to demonstrate and develop one dimensional spin transport and manipulation in Si and Ge nanowires and to develop new lateral growth method for Ge NWs on Si(001).<br>- Continued research on characterization and control of graphene edge effects.<br>- Continued research on electronic functionality in DNA nanostructures.<br>- Continued research on chemical functionalization and self-assembly of graphene nanostructures.<br>- Continued studies of how best to densitify superconducting circuits using new third generation Nb devices including what new layers devoted to resistors, filters, power distribution or wiring would provide the greatest system benefit.<br>- Completed initial demonstrations of super-conducting tunable Nb filters.<br>- Initiated research on correlated electron materials for high performance electronic devices.<br>- Initiated effort to study novel oxide materials with high electron densities for high performance transistors.<br>- Initiated research on synthesis of electronic Boron Nitride films.<br>- Initiated research on defect characterization of single layer Boron Nitride.<br>- Initiated studies of analog intelligent nanoelectronics computational architecture.<br>- Initiated research on new class of superconductors or devices in which competition between superconducting and magnetic ordering is involved.<br>- Initiated research on multi-THz electromagnetic devices lying within the intersection of high-speed electronic materials, photonic materials and active metamaterials.<br>- Initiated research on semiconductor nanowire array based transistors operating in the quantum capacitance limit for highly linear RF electronic devices and photonic nanoresonators. | | | |
| ***FY 2014 Plans:***<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Complete project on strain engineering in graphene.<br>- Complete effort on focused electron beam based angstrom-scale nano-patterning.<br>- Complete effort to observe directly the electrical properties of pair states in high temperature superconductors. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete a program investigating pattern dependent RF currents during plasma etching with design rule definitions that include provision for specific dummy structures to fill empty space and avoid these delirious effects.<br>- Complete effort to lower thermal gradients between active circuit elements and heat sinks (with 5x reduction).<br>- Initiate research on 2D materials other than graphene.<br>- Initiate research on spin properties in topological insulators.<br>- Initiate research on chemical synthesis of carbon nanostructures.<br>- Initiate research towards detecting and manipulating Majorana fermions in condensed matter systems.<br>- Initiate studies of topological insulator materials and novel device concepts exploiting properties of transport in their protected electronic state.<br>- Initiate efforts to improve the sensitivity of superconducting quantizers, mechanisms to achieve >20 GHz in-building wireless (IBW) in analog to digital converters, and explore origins of non-linearities in quantizers.<br>- Initiate studies of whether superconducting qubits can act as controllable sources of microwave entangled photons and whether these plausibly have application to quantum radar.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Complete efforts on alternative tunnel barriers for Niobium (Nb) electrode Josephson junctions for third generation digital devices.<br>- Initiate effort to maintain the ten (10) femto-second jitter produced by high speed long Josephson junction (LJJ) clocks as these pulses propagate to their point of use in coherently sampling multiple ADC and devise a Josephson junction based way of phase locking a LJJ clock to an external master clock.<br>- Initiate non-equilibrium k-space transport studies.<br>- Initiate research on micro plasma based materials, devices, and circuits. | | | |
| ***Title:*** WEAPONS | 26.292 | 17.919 | 17.936 |
| ***Description:*** 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; Counter Directed Energy and Applied Electromagnetics.<br>This activity also includes Secretary of Defense directed peer-review basic research to develop innovative solutions and enhance the science and engineering base.<br><br>Accomplishments and plans described below are examples for each effort category.<br><br>Funding decrease in FY 2014 is a result of reassignment of funding for the Basic Research Challenge Program into the newly created Research Activity. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***FY 2013 Accomplishments:***<br>Undersea Weaponry<br>- 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).<br>- Continued expansion of the Navy Undersea Research Program (NURP) 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.<br>- Continued computer code refinements and investigation of supercavitating vehicle dynamics and instability.<br>- Continued evaluation of viable synthesis methodologies and characterization of candidate explosive ingredients suitable for undersea weapons applications.<br>- Continued development of diagnostic capabilities to accurately determine aluminum combustion characteristics in oxidizing environments.<br>- Continued an Otto Fuel II characterization study for undersea weapons.<br>- 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.<br>- Continued development of concept for weaponized Unmanned Undersea Vehicles (UUVs) based on game theoretic approach.<br>- Continued validation of hydroacoustics models and test and evaluate acoustic array signal processing algorithms.<br>- Continued study on propulsion and its interaction with supercavitating cavity, and control surfaces.<br>- Continued acoustic concepts formulation and modeling for low-noise bio-inspired propulsion systems.<br>- Continued concept development on inversion of swarm dynamics for underwater tactical applications.<br>- Continued new coating concepts for corrosion and anti-fouling protection of UUVs.<br>- Continued high energy density power system research for under water vehicles.<br><br>Energetic Materials and Propulsion<br>- Continued development of a fundamental understanding of initiation mechanisms of explosive crystals subjected to shock stimulus.<br>- 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.<br>- Continued investigation of JP-10 combustion-based Proton-Exchange-Membrane (PEM) fuel cells.<br>- Continued investigation of multi-tube multi-nozzle Pulse Detonation Engines (PDEs) and multi-tube common nozzle PDEs.<br>- Continued investigation of nanometallic-hydrocarbon hybrid catalytic combustion for increased energy release rates.<br>- Continued investigation of novel initiation techniques, including optimized injection parameters, and integrated single tube operation for PDEs. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - 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.<br>- Continued to develop fundamental understanding of nitramine and perchlorate decomposition mechanisms for propellant applications.<br>- Continued to develop organometallic-based highly energetic ingredients.<br>- Continued efforts to explore alternative fuel concepts for Naval applications to include hydrogen, synthetic diesel, and biodiesel.<br>- Continued development of multi-parameter sensor for multi-phase combustion flows (UAV and underwater PDEs).<br>- Continued implementation of new & nanostructured materials design concepts for direct energy conversion and waste energy conversion.<br>- Continued investigation of integrated pulse detonation engine-airframe for autonomous vehicles, and pulse detonation for passive weapons (noise, jamming).<br>- Continued studies to determine the best investment of technologies for Unmanned Undersea Vehicle (UUV) Guidance and Control (G&C).<br>- Continued hydroacoustics models and experiments to reduce the self noise on cavitator acoustic array.<br>- Continued acoustic signal processing algorithms for HSSV guidance and control.<br>- Continued development of new concepts for underwater power generation.<br>- Continued development of non-lethal undersea warheads for Overseas Contingency Operations.<br>- Continued development of PDE for underwater applications.<br>- Continued new thrust on the design, synthesis and characterization of high energy dense oxidizers.<br>- Continued structure property relationship studies on advanced propellant systems and high blast energetic compositions.<br>- Continued synthesis and characterization of cluster complexes between reactive metals and energetic oxidizers and explosives.<br>- Initiated research and development for hypersonic propulsion system technologies for increased range and speed, improved stealth and maneuverability, reduced emissions and signatures, lower noise, wider operational envelopes and turn-down ratio.<br>- Initiated research into coulombic explosives via unique electronic and structural properties of atomic clusters not observed in bulk.<br>- Initiated development of a new methodology coordinating both theoretical and synthetic chemistry to maximize molecular design and predicted molecule stabilities. This will facilitate insight into the next generation of energetic materials.<br>- Initiated research to develop ability to synthesize and quantitatively predict energetic material performance from first principles of quantum chemistry.<br>- Initiated research and development on aircraft, fuels and rocket propulsion system technologies for: increased range and speed, improved stealth and maneuverability, reduced emissions and signatures.<br>- Initiated an investigation that focuses both theoretical and synthetic processes to maximize molecular design and crystal morphology for new insensitive munition (IM)-compliant commodity energetic material ingredients. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Expeditionary Operations<br>- Continued investigation of catalysts that reduce the pre-processing requirements for using logistic fuels in solid oxide fuel cells.<br>- Initiated basic materials research to explore and improve high strain and stress rate performance of high performance fibers,armor inserts, and structural materials.<br>- Continued basic research into automated reasoning and data fusion for distributed surveillance.<br>- Continued fundamental chemistry and materials science research to advance water purification technologies.<br>- Continued basic research to advance electrochemical energy conversion and storage.<br>- Initiated a Vehicle Autonomy effort focused on unmanned and autonomous systems to displace the operator from hazardous conditions/environments, lighten the load of individual Marines, and provide greater warfighting capability.<br><br>Directed Energy<br>- Continued research thrust in directed energy weapons.<br>- Continued 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.<br>- Continued basic research into mechanisms and concepts supporting the defeat of and protection against speed of light weapons for light tactical aerial vehicles and unmanned systems to include research into atmospheric propagation and extinction to support increased understanding of operational impacts which may affect utility of directed energy systems.<br>- Continued research into advanced theoretical research and modeling of superconducting laser elements as used in advanced high energy accelerators.<br><br>Counter Directed Energy<br>- Identified the most promising physics, science, and mathematic solutions to protect naval assets against directed energy threats.<br>- Established the basic science and technology issues relevant to the propagation of directed energy in the atmosphere and its interaction with sensors, electronics and structural materials.<br>- Initiated assessment of theoretical constructs for directed energy (DE) systems detection and geolocation.<br>- Initiated investigation into the susceptibility of critical naval electronic components to electromagnetic radiation.<br>- Initiated development of courseware for Counter Directed Energy (CDEW) for use at the U.S. Naval Academy and the Naval Postgraduate School.<br>- Initiate performance of laboratory experimentation on laser and High Power Microwave protection methods for future naval aviation systems and platforms.<br>- Initiate development of suitable metamaterial samples which provide electromagnetic shunting and conduct laboratory testing with laser and microwave systems.<br>- Initiate testing of unmanned systems DE protection methods. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Applied Electromagnetics:<br>- Continued 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.<br>***FY 2014 Plans:***<br>Undersea Weaponry<br>- Continue all efforts of FY 2012, less those noted as completed above.<br>- Complete efforts related to aluminum combustion characterization, Otto Fuel characterization, low probability of intercept sonar, nanocomposites for sonar arrays, fuel reforming and biomimetic propulsion, game theoretic weapon analysis, swarm dynamics, anti-fouling vehicle technology and countermeasure detection and classification.<br>- Initiate basic research related to cavity stability, vehicle control, maneuverability, stability associated with the development of high-speed, supercavitating vehicles.<br>- Initiate new, and continue on-going, research in fuzing phenomenology, reactive materials, high oxygen constituents and insensitive munitions and use of these technologies in advanced warhead concepts.<br><br>Energetic Materials and Propulsion<br>- Continue all efforts of FY 2013, less those noted as completed above.<br><br>Expeditionary Operations<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Initiate a new effort to research peer-to-peer mixed initiative planning to allow unmanned autonomous systems to collaborate and improve their common operating picture without having to have a human in-the-loop.<br>- Initiate Distributed Trust Models effort to determine USMC S&T gaps hindering dominance in cyberspace.<br><br>Directed Energy<br>- Complete all efforts in FY 2013, no further Basic Research in the area of Directed Energy.<br><br>Counter Directed Energy<br>- Continue all efforts of FY 2013, less those noted as completed above.<br><br>Applied Electromagnetics:<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>***FY 2015 Plans:***<br>Undersea Weaponry | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts of FY 2014, less those noted as completed above.<br>- Complete efforts in high-oxygen constituents and insensitive munitions.<br><br>Energetic Materials and Propulsion<br>- Continue all efforts of FY 2014, less those noted as completed above.<br><br>Expeditionary Operations<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Initiate development of collection strategies based on cutset sensor topologies in order to provide enhanced situational awareness with sparse sampling.<br><br>Counter Directed Energy<br>- Continue all efforts of FY 2014, less those noted as completed above.<br><br>Applied Electromagnetics<br>- Continue all efforts of FY 2014, less those noted as completed above. | | | |
| ***Title:*** BASIC RESEARCH CHALLENGE | - | 28.720 | 21.107 |
| ***Description:*** The ONR Basic Research Challenge (BRC) program was established in 2008 to competitively select and fund promising research programs in new areas not addressed by the current basic research program. In the past, the Basic Research Challenge Program has been integrated into the legacy R2 Activities to illustrate its alignment with the mainstream Naval research disciplines, but with this update BRC is being identified as its own R2 Activity to call attention to the significance it provides to new areas of Naval importance. The program stimulates new, high-risk basic research projects in multidisciplinary 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. Topics are submitted by ONR program officers and are selected for BRC awards by ONR's director of research. Basic Research Challenge award topics are then issued as a broad agency announcement.<br><br>In FY 2014 the BRC is being identified under its own Research Activity to highlight its more prominent role in stimulating competitive multidisciplinary research between ONR departments. BRC research by its nature will likely cross the traditional Research Activity boundaries and produce standout results worthy of specific focused attention.<br><br>Funding decrease in FY 2015 due to normalization of annual investment following initial emphasis in program research.<br><br>***FY 2013 Accomplishments:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| N/A<br>***FY 2014 Plans:***<br>- Continued research into the science of autonomy.<br>- Continued research into de-centralized on-line optimization.<br>- Continued research into carbon molecular electronics.<br>- Continued research into co-prime sensor array signal processing: a new framework for reduced complexity sensing.<br>- Continued research into understanding and characterizing intuition for more effective small unit decision making training technologies.<br>- Continued research into couplings of ocean to space of ionospheric drivers from below novel electronic devices based on coupled phase transitions.<br>- Continued research into biologically inspired flow field computation for sensing and control of ground vehicles.<br>- Continued research into reduced order representations for design: development of optimized algorithms for multi-physics based models.<br>- Continued research into multi-scale nonlinear mechanisms and effects associated with coupling weak energy into composite explosive compounds.<br>- Continued research into integration of advanced analysis with materials research.<br>- Continued research into towards active control of noise from hot supersonic jets.<br>- Completed research into biologically inspired intelligent metamaterials.<br>- Completed research into computing with natural language.<br>- Completed research into the microphysics of a liquid solid gas interaction.<br>- Completed research into acoustical uncertainty due to marine mammals and fish.<br>- Initiated competition for new BRC awards to address selected high priority Naval S&T areas, transformational initiatives, and grand challenges, including strategically important DoN research areas. Approximately four high priority research topics will be identified to solicit proposals.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those completed in that year. | | | |
| **Accomplishments/Planned Programs Subtotals** | 424.830 | 484.387 | 443.697 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 1 | **R-1 Program Element (Number/Name)**<br>PE 0601153N / *Defense Research Sciences* | **Project (Number/Name)**<br>0000 / *Defense Research Sciences* |

**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.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | | | | | | | | | | Date: March 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 1 | | | | | R-1 Program Element (Number/Name)<br>PE 0601153N / *Defense Research Sciences* | | | | Project (Number/Name)<br>9999 / *Congressional Adds* | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| 9999: *Congressional Adds* | - | 8.250 | 4.000 | - | - | - | - | - | - | - | - | 12.250 |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

Congressional Interest Items not included in other Projects.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 |
|---|---|---|
| ***Congressional Add:*** Nanotechnology Research (Cong) | 8.250 | 4.000 |
| ***FY 2013 Accomplishments:*** ONR issued a Special Notice in the autumn of 2012 to basic research efforts to advance the understanding of nanoscale materials and the processing thereof. All awards were completed by April 2013, and work is progressing.<br><br>Planned for the FY13 Congressional Add, ONR will issue a second Special Notice in the 4th Qtr FY2013 to solicit basic research proposals. Proposal selection and awards will be completed by June 2014. | | |
| ***FY 2014 Plans:*** N/A | | |
| **Congressional Adds Subtotals** | 8.250 | 4.000 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

Not applicable.

**E. Performance Metrics**

Congressional Interest Items not included in other Projects.

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | | | | | R-1 Program Element (Number/Name)<br>PE 0602114N *I Power Proj Applied Research* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 92.396 | 104.513 | 95.753 | - | 95.753 | 112.521 | 133.344 | 174.974 | 181.478 | Continuing | Continuing |
| 0000: *Power Proj Applied Research* | 0.000 | 83.229 | 104.513 | 95.753 | - | 95.753 | 112.521 | 133.344 | 174.974 | 181.478 | Continuing | Continuing |
| 9999: *Congressional Adds* | 0.000 | 9.167 | - | - | - | - | - | - | - | - | - | 9.167 |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

FY 2013 funding associated with Future Naval Capability (FNC) efforts were transferred to a new Program Element titled Future Naval Capabilities Applied Research (PE 0602750N). This is to enhance the visibility of the FNC Program by providing an easily navigable overview of all 6.2 FNC investments in a single location.

**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 (Sep 2011). 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, Electromagnetic Railgun (EMRG) development, Hyper Velocity Projectiles (HVP), high speed weapon propulsion, and electro-optic/infrared (EO/IR) sensor technologies.

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, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | **R-1 Program Element (Number/Name)**<br>PE 0602114N *I Power Proj Applied Research* |

| B. Program Change Summary ($ in Millions) | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 89.189 | 104.513 | 83.428 | - | 83.428 |
| Current President's Budget | 92.396 | 104.513 | 95.753 | - | 95.753 |
| Total Adjustments | 3.207 | - | 12.325 | - | 12.325 |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | 4.325 | - | | | |
| • SBIR/STTR Transfer | -2.847 | - | | | |
| • Program Adjustments | - | - | 7.842 | - | 7.842 |
| • Rate/Misc Adjustments | - | - | 4.483 | - | 4.483 |
| • Congressional General Reductions Adjustments | -8.271 | - | - | - | - |
| • Congressional Add Adjustments | 10.000 | - | - | - | - |

| Congressional Add Details ($ in Millions, and Includes General Reductions) | FY 2013 | FY 2014 |
|---|---|---|
| **Project:** 9999: *Congressional Adds* | | |
| Congressional Add: *Power Proj Applied Research (Cong)* | 9.167 | - |
| Congressional Add Subtotals for Project: 9999 | 9.167 | - |
| Congressional Add Totals for all Projects | 9.167 | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 2 | R-1 Program Element (Number/Name)<br>PE 0602114N / *Power Proj Applied Research* | Project (Number/Name)<br>0000 / *Power Proj Applied Research* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000: *Power Proj Applied Research* | - | 83.229 | 104.513 | 95.753 | - | 95.753 | 112.521 | 133.344 | 174.974 | 181.478 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** DIRECTED ENERGY | 29.569 | 40.350 | 40.470 |

***Description:*** The goal of this activity is to develop Directed Energy (DE) technology for Navy applications. The DE program addresses the requirements of future Navy combatants to provide ship defense against the emerging threats that are proliferating throughout the Navies of the world. 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. This activity also includes the Free Electron Laser (FEL) Innovative Naval Prototype (INP) which will deliver multi-mission capability.

FY 2013 to FY 2014 and FY 2014 to FY 2015 increases in funding are due to increased work on the Solid State Laser (SSL) program. The SSL-QRC program was initiated during FY 2013 and is planned to complete during FY 2015 with plans to demonstrate the system at sea in CY 2014.

***FY 2013 Accomplishments:***

Directed Energy and Accelerator Research:
- Continued to develop the most promising component technologies such as normal conducting and super conducting RF electron beam injectors, advanced high power cathode technologies, high power compact amplifiers, and advanced mirrors, coatings and optical components capable of handling the significantly higher energies. Consider analysis of smaller FEL system designs.

Applied Electromagnetics for High Power Weapons:
-Completed the development of Gallium Nitride as an advanced nonlinear optic material.
-Completed applied research into applied electromagnetics as it relates to lasers, high power microwaves, and advanced sensors for Directed Energy Weapons.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602114N / *Power Proj Applied Research* | **Project (Number/Name)**<br>0000 / *Power Proj Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Solid State Laser - Technology Maturation (SSL-TM):<br>-Initiated the development of technologies suitable for a solid state laser weapon system, including technologies for maritime beam director, targeting and laser subsystems, which are capable of supporting future Navy missions to defeat small boat swarms, UAV swarms, and provide potential ISR disruption and/or defeat. This work supports future prototype developments and will include laser subsystem (potentially both slab and fiber solid state systems) and required beam director scientific studies. The focus of the effort will be to support the development and advancement of future Navy Solid State Laser prototypes, including the development of lethality studies and atmospheric characterization. These scientific studies are critical to understand and support missions identified for a layered defensive capability, in the maritime environment, which shall include robust modeling and simulation of atmospheric absorption and turbulence.<br>-Conducted lethality testing for notional solid state laser designs. This will include scientific studies of laser erosion, pitting, and ablation of various target materials for improved modeling and simulation, that will support development of the governing technical requirements for a beam director and targeting system capable of performing Navy surface ship self defense missions.<br>-Initiated and conducted studies of atmospheric absorption and turbulence, suitable to evaluate notional maritime beam director subsystems, and including studies in adaptive optics for improved lethality performance in low altitude, maritime surface conditions. These scientific studies are critical to understanding the impact of boundary layer and sea-water-air turbulent mechanics on future laser weapons systems and interfaces.<br>-Initiated and conducted trade studies on innovative solid state laser subsystems designs, based off industry available technologies or those technologies identified by the High Energy Laser Joint Technology Office (HEL JTO). These investments will be considered "break through" type of investments, which require additional scientific study to determine their potential for near term capability improvements in a future naval prototype system.<br>-Initiated and conducted scientific studies on laser subcomponents, including laser pump diodes and laser gain media, which have the potential to support future acquisition programs, but are based on solid state laser technologies. Efforts in this area will focus on emerging commercial technologies and government sponsored research, which are suitable for use in a maritime domain. Research and technology developments will include advancements suitable for use by either solid state slab or solid state fiber optic laser subsystems - and which if matured, would enable rapid scientific advancements and improve specific systems performance against key performance parameters.<br>-Initiated and conducted scientific trade studies of notional predictive avoidance systems, which examine the control interfaces between sensors and future prototypical naval laser weapons, which would provide an inherent "safe-arm" function for the projecting of laser power at long range (potentially beyond typical visible, line of sight distances.) Of particular concern is the designs for safety in future laser weapons to halt laser energy propagation, while performing Navy surface ship self defense missions, and avoid inadvertent illumination of non-threat forces (e.g. friendly sensors or platforms.) | | | |
| ***FY 2014 Plans:***<br>Directed Energy and Accelerator Research: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602114N / *Power Proj Applied Research* | **Project (Number/Name)**<br>0000 / *Power Proj Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| -Continue all efforts of FY 2013 unless noted as completed above.<br><br>Solid State Laser - Technology Maturation (SSL-TM):<br>-Continue all efforts of FY 2013 unless noted as completed above.<br>-Complete Concept Design Phase (Phase I) and Concept Design Review (CODR). Results of the CODR will be used to identify contractors and concepts for continuation in Phase II. Phase II will develop a detailed design and will include a Preliminary Design Review (PDR) during FY14 and a Critical Design Review during FY15 (CDR).<br>-Initiate land based testing and evaluation of SSL Advanced Beam Director prototypes which have been ruggedized and suitable for long term exposure to a maritime environment as will be seen by naval combatants.<br><br>***FY 2015 Plans:***<br>Directed Energy and Accelerator Research:<br>-Continue all efforts of FY 2014 unless noted as completed above.<br><br>Applied Electromagnetics for High Power Weapons:<br>-Program was completed in FY 2013.<br>-Complete the development of Gallium Nitride as an advanced nonlinear optic material.<br><br>Solid State Laser - Technology Maturation (SSL-TM):<br>-Continue all efforts of FY 2014 unless noted as completed above.<br>-Conduct component and subcomponent laboratory tests.<br>-Complete Critical Design Phase, CDR and begin fabrication of Full SSL TM System. Results from CDR may be used to identify contractors and concepts for continuation during Phase III of the program. Phase III will include fabrication of a full laser weapons systems, shipboard integration, land based testing and sea based testing on a navy surface combatant at sea during FY 2016/2017. | | | |
| ***Title:*** HIGH SPEED PROPULSION AND ADVANCED WEAPON TECHNOLOGIES | 16.923 | 16.427 | 3.919 |
| ***Description:*** The high speed weapons work in this activity is focused on demonstrating propulsion and vehicle technologies for Mach3+ to Mach8 capable weapons. 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 Surface Fire Support weapons. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602114N / *Power Proj Applied Research* | **Project (Number/Name)**<br>0000 / *Power Proj Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| FY 2014 to FY 2015 decrease is due to transition of the Hypervelocity Projectile to an FNC program PE's 0602750N and 0603673N.<br><br>***FY 2013 Accomplishments:***<br>-Continued effort to develop advanced guidance and control technologies for high speed weapons.<br>-Initiated high temperature capable thermal management, insulator and ablative technology investigations.<br>-Continued high speed propulsion and integrated airframe technology development to enhance system range, responsiveness and reliability.<br>-Continued investigations into advanced material solutions to high speed airframes and air systems operating in maritime environments.<br>-Continued high temperature capable thermal management, insulator and ablative technology investigations.<br>***FY 2014 Plans:***<br>-Continue all efforts of FY 2013 unless noted as completed above.<br>-Initiate technology maturation of advanced airframes and controls, high gee components and miniaturization of electronics.<br>***FY 2015 Plans:***<br>-Continue all efforts of FY 2014 unless noted as completed above.<br>-Transition HVP program to an FNC.<br>-Initiate high speed hypersonic weapons technology program to provide exploratory development of enabling very long range hypersonic boost-glide missiles and hypersonic ship-launched projectiles.<br>-Initiate development of advanced computational and experimental techniques for hypersonic boundary layer transition.<br>-Initiate High Temperature thermal management research.<br>-Initiate Ultra-high temperature materials research for hypersonic leading edges and nose tips. | | | |
| ***Title:*** NAVIGATION, ELECTRO OPTIC/INFRARED (EO/IR), AND SENSOR TECHNOLOGIES | 8.251 | 4.432 | 3.882 |
| ***Description:*** This activity describes Navy Science and Technology (S&T) investments in the areas of EO/IR devices and advanced sensors and includes investment/performance in the technology areas of Electronics, Electronic Warfare, and Communications.<br><br>The decrease from FY 2013 to FY 2014 is due to transfer of funding and associated efforts supporting the NEMESIS development of RF EW payloads for unmanned aerial systems to PE 0602271N, and transfer of NEMESIS development of distributed control, coordination, and networking of payloads and platforms to PE 0602235N.<br><br>***FY 2013 Accomplishments:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602114N / *Power Proj Applied Research* | **Project (Number/Name)**<br>0000 / *Power Proj Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Electro Optic/Infrared:<br>-Completed effort to develop power scaling of interband and quantum cascade lasers for mid-wave and long-wave infrared spectral bands.<br>-Initiated development of structured dielectric elastomers for electromechanical devices and deformable optics.<br>-Initiated development of magneto-optic materials and ultra-high sensitivity, room-temperature magnetic field sensors.<br><br>Electronic Warfare:<br>-Completed evaluation of long-range power beaming capabilities using high-power CW fiber lasers and advanced laser power converters to increase the flight duration and operational capabilities of EW UAVs.<br>-Completed the development of technologies for autonomous in-flight reconfiguration to increase flight endurance of EW UAS.<br>-Completed effort to develop germanium optical detectors on silicon substrates for high power density, high frequency applications.<br>-Initiated efforts for LA - Unmanned Aerial System (UAS) Based EW: The objective is to develop a System of Systems (SoS) able to artificially create the appearance of a realistic naval force to many adversary surveillance and targeting sensors simultaneously. It will benefit the warfighter by providing battlespace confusion to adversary surveillance and targeting systems both above and below water, creating seamless cross-domain countermeasure coordination, and enabling rapid advanced technology/capability insertion to counter emerging threats. Technology developments will include reconfigurable and modular EW payloads, Distributed Decoy and Jammer Swarms (DDJS), effective acoustic countermeasures (CM), and Multiple Input/Multiple Output Sensor/CM (MIMO S/CM) for false force generation to both above and below water sensors.<br>-Continued development of ultra low noise uncooled nanotechnology infrared sensors.<br>-Continued development nanoatomic sensor nonvolatile memories.<br>-Continued development of electronic field of view and zoom imagers.<br>-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.<br>-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.<br>-Continued effort to develop mid & long wave IR focal plane arrays using graded-bandgap W-type-II. Superlattices with much higher detectivity than that of state-of-the-art HgCdTe (MCT).<br>-Initiated development and prove a method of more efficiently transporting EW sensors using a low Reynolds Number regime boundary layer control system.<br>-Initiated the development of a water assisted take-off process for electronic warfare sensors. | | | |
| ***FY 2014 Plans:***<br>Electronic Warefare: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602114N / *Power Proj Applied Research* | **Project (Number/Name)**<br>0000 / *Power Proj Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| -Continue all efforts of FY 2013 unless noted as completed above.<br>-Complete development and prove a method of more efficiently transporting EW sensors using a low Reynolds Number regime boundary layer control system.<br><br>***FY 2015 Plans:***<br>Electronic Warfare:<br>-Continue all efforts of FY 2014 unless noted as completed above.<br>-Complete development and prove a method of more efficiently transporting EW sensors using a low Reynolds Number regime boundary layer control system.<br>-Complete the development of a water assisted take-off process for electronic warfare sensors. | | | |
| ***Title:*** STRIKE AND LITTORAL COMBAT TECHNOLOGIES<br><br>***Description:*** 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.<br><br>***FY 2013 Accomplishments:***<br>-Initiated the development and demonstration of new Electronic Protection (EP) techniques that can discriminate advanced jamming false targets from true targets and also suppress false targets so that true targes can be readily detected.<br>-Continued development of multistatic electronic protection techniques against advanced jamming systems.<br><br>Enhanced Weapon Technologies:<br>-Continued 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.<br>-Continued 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.<br><br>Strike Accelerator:<br>-Continued Strike Accelerator program. This effort will provide an advanced airborne capability to accurately identify targets using Advanced Target Recognition (ATR). These capabilities are utilizing the F/A-18 E/F, AESA (Active Electronically Scanned Array) Radar and ATFLIR (Advanced Targeting Forward Looking Infrared) sensors. | 0.657 | 0.769 | 0.763 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602114N / *Power Proj Applied Research* | **Project (Number/Name)**<br>0000 / *Power Proj Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Multi-Target Laser Designator:<br>- Continued research for advanced optical techniques to defeat SWARM attacks.<br><br>Selectable Output Weapon:<br>- Continued Selectable Output Weapon Sea Strike Project<br><br>High Energy Fiber Laser System:<br>- Continued development an advanced laser beam control, pointing mechanism and power subsystem to support an airborne laser weapon system. This system will provide the detection and defeat of current and future threats.<br>***FY 2014 Plans:***<br>Continue all efforts of FY 2013 unless noted as completed above.<br>***FY 2015 Plans:***<br>Increased Capability Against Moving and Stationary Targets:<br>-Continue all efforts of FY 2014 unless noted as completed above.<br>-Complete development of multistatic electronic protection techniques against advanced jamming systems. | | | |
| ***Title:*** WMD DETECTION | 3.721 | 1.955 | - |
| ***Description:*** 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 Maritime domain. 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.<br><br>FY 2013 to FY 2014 decrease is due to realignment of funds to high priority requirements. FY 2014 to FY 2015 decrease is due to program completion.<br><br>***FY 2013 Accomplishments:***<br>-Completed modeling and simulation efforts to determine the ability to use neutron activation analysis and passive detectors to locate smuggled nuclear weapons and material in maritime scenarios.<br>-Completed investigation in using particle beam (neutrons and photons) to perform standoff detection of fissile material.<br>-Completed the development of technologies for remote real time imaging of suspected WMD in a maritime environment for both Passive Detection and Active Interrogation, including laboratory and field testing.<br>-Completed the development of technology for and conduct radiological WMD Detection from Naval UAV platforms. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602114N / *Power Proj Applied Research* | **Project (Number/Name)**<br>0000 / *Power Proj Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| -Continued the technical development and testing of solid state high energy neutron detector without Helium 3.<br>-Continued the development of a compact human portable Neutron Generator for enhanced mobile detection technology.<br>-Continued field experiments for Passive Interrogation of SNM simulants using UUV's<br>-Continued technology study of 3 Helium free silicon based replacement radiological detectors<br>-Continued examination of CONOPS and strategies for supporting Naval Maritime Interdiction (MIO) and VBSS missions.<br>-Continued development and testing of 3 Helium free silicon based replacement radiological detectors strategies for supporting Naval Maritime Interdiction (MIO) and VBSS missions.<br>-Continued development of hand held and portable detector technology for maritime interdiction.<br>-Completed radiological testing and active interrogation.<br><br>Detection from unmanned underwater vehicles (UUVs)<br>-Initiated the development of technology for and conduct radiological WMD Detection from Naval aviation platforms.<br>-Initiated examination of system human dose limits and health effects of various Remote Stand Off Detection techniques.<br>-Initiated acquisition of WMD Special Nuclear Materials (SNM) simulator from DOE.<br>-Initiated high fidelity field testing.<br>***FY 2014 Plans:***<br>-Continue all FY 2013 plans unless noted as completed above.<br>-Complete examination of CONOPS and strategies for supporting Naval Maritime Interdiction (MIO) and VBSS missions.<br>-Complete the technical development and testing of solid state high energy neutron detector without Helium 3.<br>-Complete the development of a compact human portable Neutron Generator for enhanced mobile detection technology.<br>-Complete field experiments for Passive Interrogation of SNM stimulants using UUV's.<br>-Continue development and testing of 3 Helium free silicon based replacement radiological detectors strategies for supporting Naval Maritime Interdiction (MIO) and VBSS missions.<br>***FY 2015 Plans:***<br>N/A | | | |
| ***Title:*** ELECTROMAGNETIC GUNS<br>***Description:*** This activity is the Electro Magnetic (EM) railgun program that is focused on developing the technology to launch a long range projectile from Navy ships. EM railgun is being considered for multi-mission applications including USMC Naval Surface Fire Support, anti-surface warfare (ASUW) and ship self defense from missiles and small boat threats.<br><br>FY 2013 to FY 2014 and FY 2014 to FY 2015 increase is due to planned pulsed power development and fabrication required to support repetitive rate testing. | 24.108 | 40.580 | 46.719 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602114N / *Power Proj Applied Research* | **Project (Number/Name)**<br>0000 / *Power Proj Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***FY 2013 Accomplishments:***<br>-Continued launcher development.<br>-Continued material, physics and thermal property research for single shot launchers, pulsed power and projectiles for 32MJ muzzle energy launch; and initiated assessments from next generation, rep rate, and operational environments.<br>-Continued IPT and Bore Life Consortium collaborations for 32 MJ launchers.<br>-Continued material applications and component design assessments for next generation repetitive fires.<br>-Initiated development of modeling and simulation capability to support bore life development and testing for rep rate bore life development assessments.<br>***FY 2014 Plans:***<br>-Continue all efforts of FY 2013 unless noted completed above.<br>-Initiate additional next generation pulsed power fabrication as part of a multi-module, multi-year build to increase full scale rep rate capability from 20MJ to 32MJ muzzle energy capability.<br>***FY 2015 Plans:***<br>-Continue all FY 2014 efforts | | | |
| **Accomplishments/Planned Programs Subtotals** | 83.229 | 104.513 | 95.753 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

This PE develops early components technologies that 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

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602114N / *Power Proj Applied Research* | **Project (Number/Name)**<br>0000 / *Power Proj Applied Research* |

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.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 2 | R-1 Program Element (Number/Name)<br>PE 0602114N / *Power Proj Applied Research* | Project (Number/Name)<br>9999 / *Congressional Adds* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9999: *Congressional Adds* | - | 9.167 | - | - | - | - | - | - | - | - | - | 9.167 |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

Congressional Interest Items not included in other Projects.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 |
|---|---|---|
| ***Congressional Add:*** Power Proj Applied Research (Cong) | 9.167 | - |
| ***FY 2013 Accomplishments:*** The UTC initiative continued to design, develop, integrate, test and demonstrate a gun hardened Guidance, Navigation, Control and Targeting (GNC&T) system. UTC was leveraging its technologies and system components to enhance the value added for precision guided munitions. As part of the initiative, UTC is developing a shortwave infra-red (SWIR) low cost multimode seeker. Employing advanced technologies inherent in reconnaissance cameras these devices serve as both a superior semi-active laser (SAL) and a high resolution imaging seeker. In FY13, UTC submitted milestone deliverables with a summary system technical data package complete with functional flow diagrams, performance requirements, and system architecture. UTC delivered a prototype SWIR seeker complete with performance predictions based on field test data. The remainder of FY13 focused on integration and functionality into a compact, miniaturized modular seeker configuration and engineering builds and testing in laboratory environments and supersonic rocket testing to collect additional survivability and performance characteristics. | | |
| ***FY 2014 Plans:*** N/A | | |
| **Congressional Adds Subtotals** | 9.167 | - |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

Not applicable.

**E. Performance Metrics**

Congressional Add

THIS PAGE INTENTIONALLY LEFT BLANK

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | | Date: March 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | | | | | R-1 Program Element (Number/Name)<br>PE 0602123N *I Force Protection Applied Res* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 188.995 | 170.288 | 139.496 | - | 139.496 | 128.363 | 128.717 | 125.230 | 125.512 | Continuing | Continuing |
| 0000: *Force Protection Applied Res* | 0.000 | 128.494 | 145.288 | 139.496 | - | 139.496 | 128.363 | 128.717 | 125.230 | 125.512 | Continuing | Continuing |
| 9999: *Congressional Adds* | 0.000 | 60.501 | 25.000 | - | - | - | - | - | - | - | - | 85.501 |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

FY 2013 funding associated with Future Naval Capability (FNC) efforts are transferring to a new Program Element titled Future Naval Capabilities Applied Research (PE 0602750N). This is to enhance the visibility of the FNC Program by providing an easily navigable overview of all 6.2 FNC investments in a single location.

**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 (Sep 2011). 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.

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, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | **R-1 Program Element (Number/Name)**<br>PE 0602123N *I Force Protection Applied Res* |

| B. Program Change Summary ($ in Millions) | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 143.301 | 145.307 | 147.814 | - | 147.814 |
| Current President's Budget | 188.995 | 170.288 | 139.496 | - | 139.496 |
| Total Adjustments | 45.694 | 24.981 | -8.318 | - | -8.318 |
| • Congressional General Reductions | - | -0.019 | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | 25.000 | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | 0.450 | - | | | |
| • SBIR/STTR Transfer | -4.224 | - | | | |
| • Program Adjustments | - | - | -8.240 | - | -8.240 |
| • Rate/Misc Adjustments | -0.001 | - | -0.078 | - | -0.078 |
| • Congressional General Reductions Adjustments | -16.531 | - | - | - | - |
| • Congressional Add Adjustments | 66.000 | - | - | - | - |

| Congressional Add Details ($ in Millions, and Includes General Reductions) | FY 2013 | FY 2014 |
|---|---|---|
| **Project:** 9999: *Congressional Adds* | | |
| Congressional Add: *Alternative Energy Research* | 36.483 | 25.000 |
| Congressional Add: *Materials Research and Technology* | 12.009 | - |
| Congressional Add: *Power Generation and Storage Research* | 12.009 | - |
| Congressional Add Subtotals for Project: 9999 | 60.501 | 25.000 |
| Congressional Add Totals for all Projects | 60.501 | 25.000 |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 2 | R-1 Program Element (Number/Name)<br>PE 0602123N / *Force Protection Applied Res* | Project (Number/Name)<br>0000 / *Force Protection Applied Res* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000: *Force Protection Applied Res* | - | 128.494 | 145.288 | 139.496 | - | 139.496 | 128.363 | 128.717 | 125.230 | 125.512 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** AIRCRAFT TECHNOLOGY | 46.372 | 60.655 | 53.048 |
| ***Description:*** The Aircraft Technology activity develops technologies for reduced observables technology and enhanced capability of naval aviation aircraft platforms in terms of mission effectiveness, platform range, responsiveness, survivability, observability, readiness, safety and life cycle cost. 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 systems, aerodynamics, propulsion systems, materials, structures and flight controls for future and legacy air vehicles. This activity directly supports the Naval Aviation Enterprise Science and Technology Objectives and the Naval Science and Technology Strategic Plan, principally in the Autonomy and Unmanned Systems, Platform Design and Survivability, Power and Energy and Total Ownership Cost Focus Areas, Sea-Based Aviation was designated as a National Naval Responsibility (SBA NNR) in FY 2011 and will refocus investments beginning in FY 2014 in areas that are Naval unique or dominated by Naval requirements.<br><br>Variable Cycle Advanced Technology (VCAT) will identify and mature critical, relevant variable/adaptive cycle propulsion system technologies for the next generation carrier-based TACAIR/ISR systems. Autonomous Aerial Cargo/Utility System (AACUS) will develop advanced autonomous capabilities to enable rapid resupply of distributed forces in the short term. The SBA NNR Structures and Materials program will develop the next generation structural capability and material response science for aircraft technology in fixed and rotary wing, manned and unmanned airframe technology to achieve reduced weight, increased durability, strength, streamlined manufacturability, reduced life-cycle cost and maintenance/readiness gaps improvements. Program payoffs include increased availability/readiness, reduced sustainment requirements, fatigue/loads life enhancement, reduced weight and improved range, and advanced prognostics design tools. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Beginning in FY 2014, applied research efforts will begin under the Sea-Based Aviation National Naval Responsibility (SBA NNR) Propulsion thrust area as well, resulting in the funding increase in FY 2014.<br><br>These efforts addresses unique attributes to propulsion and power technologies for Naval Aviation, as well as those having higher importance to Naval Aviation and some that are more pervasive to all of military aviation. Related basic research efforts are addressed under 0601153N.<br><br>The funding decrease from FY 2014 to FY 2015 is due to the AACUS funding decreasing significantly as the effort is nearing completion.<br><br>***FY 2013 Accomplishments:***<br>- Complete effort to develop a portable system for stand-off detection of explosives and other illicit materials, including trace residues.<br>- Initiate development of rotorcraft/VTOL systems automated launch and recovery technology.<br>- Initiate mixed-mode mechanical/environmental failure prediction research.<br>- Initiate advanced composite durability technology.<br>- Initiate material degradation risk prediction and operational environment-driven materials selection methods.<br>- Initiate demonstration of initial core software, sensor, air vehicle, and capability applications for Autonomous Aerial Cargo/Utility System (AACUS).<br>- Initiate the advanced technology demonstration portion of the Variable Cycle Advanced Technology (VCAT) Program. Critical technology development efforts will begin with major engine manufactures and system contractors to develop/mature the highest priority, long-lead propulsion system technologies, including variable/adaptive cycle engine components, for next generation carrier-based TACAIR/ISR systems.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Complete VCAT Application Studies systems analysis efforts and the majority of Phase I variable cycle engine/propulsion subsystem technology development efforts.<br>- Complete experiments on user interaction methods/decision tools for future deck operations with mixed manned and autonomous air systems.<br>- Complete efforts on autonomy for low-altitude persistence by small UAVs.<br>- Complete effort to demonstrate the solution processing of an inorganic nanowire based photovoltaic device that operates in the infrared region. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate new efforts on high confidence/Safe Autonomous Control in naval environments and on supervisory control of decentralized heterogeneous UAS.<br>- Initiate SBA NNR related projects in Virtual Ship/Aircraft Dynamic Interface, Manned/Unmanned Handling Qualities and Control, Automated Deck Operations, High Lift Aerodynamics and Vertical/Short Takeoff and Landing (V/STOL) Operations.<br>- Initiate applied research efforts under the Sea-Based Aviation National Naval Responsibility Propulsion thrust area.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Continue VCAT Phase I variable cycle engine/propulsion subsystem technology development efforts through completion.<br>- Continue to explore and evaluate future aircraft concepts and their associated enabling technologies.<br>- Continue development of survivability/reduced observables technology. Metrics are classified.<br>- Initiate new efforts on safe-perception based autonomous control in complex naval environments and on autonomy to support combined unmanned and manned air systems/units.<br>- Initiate airplane launch and recovery component and subsystem technology developments to enable medium size long endurance, long range UAVs to be lauched and recovered on short deck ships. | | | |
| ***Title:*** FLEET FORCE PROTECTION AND DEFENSE AGAINST UNDERSEA THREATS | 2.183 | 1.408 | 1.627 |
| ***Description:*** Fleet Force Protection and Defense against Undersea Threats efforts include applied research for complementary sensor and processing technologies for platform protection. Current small platforms (both surface and airborne) have little to no situational awareness (SA) or self-protection against air, surface, and asymmetric threats. A goal of this activity is to provide these platforms with effective self-protection. The technology areas specific to platform protection will develop individual, multispectral electro-optical (EO), infrared (IR), radio frequency (RF), electro-magnetic (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.<br><br>The funding decrease from FY 2014 to FY 2015 is due to re-scoping/re-phasing of various efforts in this R-2 Activity. This re-scoping was done to re-prioritize S&T investments.<br><br>***FY 2013 Accomplishments:***<br>Sensors & Associated Processing:<br>- Continued efforts in biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing algorithms.<br>- Continued efforts in biomimetic signal processing: panoramic periscope for submarines and temporal pattern recognition for Systems for Security Breaching Noise Detection. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued efforts in bioinspired quiet, efficient and maneuverable self-propelled line array using high-lift propulsors based on insect biomechanics.<br>- Continued studies to develop catalytic activity profile of bioactive coatings against chemical agents.<br>- Continued design and initiated fabrication of coatings to degrade both, chemical and biological agents.<br>- Continued efforts to design microfabricated system for 3-color fluorescence measurements using integrated waveguides.<br>- Continued effort to develop new, highly selective, preferential oxidation catalysts for the generation of power from the reformate gas purification process.<br>- Continued effort to develop aspheric gradient index optics<br>***FY 2014 Plans:***<br>Sensors & Associated Processing<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>***FY 2015 Plans:***<br>Sensors & Associated Processing:<br>- Continue all efforts of FY 2014.<br>- Complete development of distributed environmental microsensors for analyte dectection. | | | |
| ***Title:*** MISSILE DEFENSE (MD)<br>***Description:*** This activity describes Missile Defense S&T projects.<br><br>The funding decrease from FY 2014 to FY 2015 is due to re-scoping/re-phasing of various efforts in this R-2 Activity. This re-scoping was done to re-prioritize S&T investments.<br>***FY 2013 Accomplishments:***<br>- Continued missile defense related efforts.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013<br>***FY 2015 Plans:***<br>N/A | 1.703 | 1.186 | - |
| ***Title:*** ADVANCED ENERGETICS<br>***Description:*** Advanced Energetics efforts address technology development to provide substantial improvements in energetic material systems and subsystems, primarily in terms of performance, but also addressing safety, reliability, and affordability concerns. Goals include: advanced energetic materials for warheads, propellants, and reactive material based subsystems | 3.668 | 4.187 | 5.052 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| 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.<br><br>***FY 2013 Accomplishments:***<br>- Continued Advanced Energetics research in development and evaluation of advanced explosive/propellant/reactive ingredients and formulations for the next generation higher performing systems.<br>- Continued proof-of-concept efforts to develop insensitive explosives, propellants, and munitions without compromising performance.<br>- Continued Advanced Energetics research in development and diagnostics of novel energy conversion concepts.<br>- Continued non-traditional energy conversion studies with columbic and cluster material investigations.<br>- 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.<br>- Continued Advanced Energetics research in development of advanced directed hydro-reactive material warhead concepts to enhance performance of undersea warheads.<br>- 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.<br>- Continued Advanced Energetics research in advanced multiphase blast concepts employing dense metalized explosives to enhance performance of air and underwater blast warheads.<br>- 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<br>- Continued 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 Electromagnetic Rail Gun, PE 0603114N.<br>- Continued 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.<br>- Continued development and evaluation of energetic ingredients and formulations for next generation higher performance applications. Conclude scale-up development and testing. - Initiated processing optimization studies for MTX-1 (1-[(2E)-3-(1H-tetrazol-5-yl)triaz-2-en-1-ylidene] methanediamine), an additive to percussion primers.<br>- Continued the processing optimization design of material compositions for Reactive Material explosive fragment applications. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued optimization and refinement studies of Poly NitratoOxetane (3-PNO) process for solid rocket motor propellants.<br>- Continued the development of a reliable chemical scale-up and material specification process techniques.<br>- Continued ultra-high density reactive material investigations (13 - 15 grams/cc) for the next generation reactive material warhead material (formulations, material properties, target interaction, letality models, and experiments).<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013.<br>- Complete Studies on Poly NitratoOxetane (3-PNO).<br>- Initiate process research and development of Ammonium Nitrotetrazolate-2N-oxide (AONT).<br>- Initiate process optimization of Ammonium Tetrakis (3,5-Dinitro-1,2,4-Triazolyl)Borate (ATDTB).<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as complete above.<br>- Complete Studies on MTX-1 (1-[(2E)-3-(1H-tetrazol-5-yl)triaz-2-en-1-ylidene] methanediamine), an additive to percussion primers.<br>- Complete Advanced Energetics research in development of advanced directed hydro-reactive material warhead concepts to enhance performance of undersea warheads.<br>- Complete process optimization of Ammonium Tetrakis (3,5-Dinitro-1,2,4-Triazolyl)Borate (ATDTB).<br>- Initiate research on new caged nitramines<br>- Initiate process research and development of 1,1'-Diamino4,4',5'5'-Tetranitro-2,2'-Biimidiazole (DATNBI)<br>- Initiate process research and development of 1-Fluoro-4,5-Dinitroimidazole. | | | |
| ***Title:*** SURFACE SHIP & SUBMARINE HULL MECHANICAL & ELECTRICAL (HM&E) | 70.668 | 73.524 | 75.302 |
| ***Description:*** Efforts include: signature reduction, hull life assurance, hydromechanics, distributed control for automated survivability (includes damage control), and advanced naval 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 interaction and maneuvering. Distributed intelligence for automated survivability addresses both the basic technology of automating machinery control systems, as well as, distributed control of systems utilizing autonomy for mission context based reconfiguration. Unmanned Sea Surface Vehicle applied research includes short-term motion forecasting for recovery of USSVs on a host ship in higher sea states and determination of slamming loads on high-speed planing hulls for structural weight reduction. Advanced naval 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: developing technologies to improve warfighting capability with more | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| energy efficient systems; reducing the time & cost to certify alternative fuels, and mitigate adverse alternative fuel impacts on Naval platforms and equipment; developing sustainable biomass models to support alternative fuel availability to Naval forces; utilizing the Electric Ship Research and Development Consortium (ESRDC) efforts to develop modeling and simulation tools to provide critical design & operational capabilities for the all-electric ship program, accelerate development and demonstration of technologies, reduce risk of new technology insertion and address the national shortage of electrical power engineers. Efforts for ONR Science Advisors are also funded in this R-2 Activity. Long Endurance UUV technologies will deliver to the Office of Naval Research modular fuel cell systems for UUVs, including practical systems demonstrations, and a path forward for future developments. It will also keep the US Navy at the forefront of advanced electric propulsion technologies.<br><br>The funding increase from FY 2014 to FY 2015 is due to the increase in the Applied Research Challenge and an increase in Counter-IED effort.<br><br>***FY 2013 Accomplishments:***<br>Survivable Platforms - Reduced Signatures<br>- Continued advanced numerical acoustic codes (and gridding methods for those codes) for submarines.<br>- Continued mmWave Signatures measurement to identify key signature characteristics.<br>- Continued Alternating Current (AC) propagation experiments.<br>- 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.<br>- Continued development of quiet control surface design tool based on control surface flow noise studies.<br>- Continued IR and radar detectability prediction capability.<br>- Continued surface ship super-conductive degaussing with laboratory demonstration loop for Electromagnetic (EM) field accuracy measurements and control methods.<br>- Continued testing on Advanced Electric Ship Demonstrator (AESD) to assess energy propagation and acoustic radiation mechanisms and to develop mitigation concepts for surface ships.<br>- Continued IR assessment of two advanced treatments.<br>- Continued first of a series of IR validation experiments and critical sensitivity analysis.<br>- Continued Improved Corrosion Related Magnetic (CRM) Field Prediction Model to design compensation systems to reduce ship's CRM signature.<br>- Continued assessment of ship biostatic Radar Cross Section (RCS).<br>- 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. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued experimental effort to characterize electric drive motor signature mechanisms and verify modeling and simulation approaches for signature prediction.<br>- Continued development of modeling methods and noise control concepts for modular/reconfigurable submarine architectures.<br>- Continued investigation into hull treatment concepts for acoustic signature/vibration control for surface ships.<br>- Continued development of advanced RF metamaterials for platform signature control.<br>- Continued development of signature modeling approaches for electric actuation and alternate electric drive system architectures.<br>- Continued development of Low probability Intercept (LPI) technologies for surface ship emissions including communication, navigation, electronic warfare, and combat systems.<br>- Continued advanced EM modeling tools development and validation.<br>- Continued next generation deckhouse integration technology development.<br>- Continued modeling of hydroacoustics of turbulence-propulsor interaction.<br>- Continued joint effort with UK/MoD on adhesively joined aluminum in lieu of welding of marine structures and thus reduce cost.<br>- Continued joint effort with NLRN on adhesive joined composite to metals in lieu of bolting of marine structures and thus reduce cost for topside structures.<br>- Continued efforts on shock mitigation and shock diversion for ship hulls to reduce cost of machinery mounts and equipments, based on successful results from the ERC helmets for protection against TBI.<br><br>Survivable Platforms - Hull Life Assurance<br>- Initiated efforts on combinations of highly rate-sensitive materials through experiment and modeling for extreme hyper velocity threat conditions.<br>- Continued development of global surface wave measurement capability for ship models.<br>- Continued Dynamic Behavior of Composite Ship Structures (DYCOSS) (joint effort with Dutch Navy).<br>- Continued development of structural analysis codes describing failure mechanism of sandwich composites.<br>- Continued Explosion Resistant Coatings (ERC) effort, providing US input to trilateral agreement with UK and Australia.<br>- Continued composite and composite-metal hull performance characterization and testing including structural loading, thermal stress and signatures.<br>- Continued effort on an advanced class of polymers as a follow-on to current ERC for application against advanced threats.<br>- Continued Payload Implosion and Platform Damage Avoidance efforts.<br>- Continued development of reliability-based recoverability methods for assessing damaged ship structures.<br>- Continued development of advanced analytical, numerical and experimental methods in support of platform signature reduction.<br>- Continued effort on exploitation of polymers for the deflection and dissipation of shock wave impact on ship and submarine hull structures.<br><br>Survivable Platforms - Distributed Intelligence for Automated Survivability | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of modeling and simulation methods for robust design and virtual testing of integration of shipboard auxiliary systems including their control systems.<br>- Continued research into advanced HM&E system reconfiguration approaches, including agent-based control systems and algorithms, and model-based reasoning.<br>- Continued demonstration of Genetic Algorithm(s) for determining optimal distributed system control strategy.<br>- Continued development of Survivability Analysis Algorithms Operable on a Total Ship Modeling Environment.<br>- Continued the transition of the small scale hardware-in-the-loop demonstrator to the academic community for challenge problem formulation.<br>- Continued demonstration of the developed model based reasoning control algorithms on full scale hardware test beds.<br><br>Advanced Platforms - Advanced Platform Concepts and Designs:<br>- Continued validation of asymmetric hull forms with experimental data.<br>- Continued development of analytical models to further define submarine modular hull concepts.<br>- Continued development of reliability based design and structural analysis code development.<br>- Continued development design tools for integrated antenna and composite topside.<br>- Continued circulation control analysis for three-dimensional flow effects.<br>- Continued aperstructures microwave communication system.<br>- Continued concept for Ultra High Frequency (UHF)/Very High Frequency (VHF) aperstructures opportunistic array (Advanced Hull-form Inshore Demonstrator - AHFID).<br>- Continued development of methods for determining reliability and vulnerability of aluminum ship structures.<br>- Continued large scale demonstration efforts of advanced mitigation technologies.<br>- Initiate large scale demonstration efforts of advanced mitigation technologies.<br><br>Advanced Platforms - Hydromechanics:<br>- Continued experimental database/computational tools development for extreme submarine maneuvers (e.g., crashback).<br>- Continued the validation of circulation control and advanced control surfaces with experiments.<br>- Continued to investigate improved maneuvering simulation capability for submarines.<br>- Continued validation of Reynolds Average Navier-Stokes (RANS) code for advanced waterjet propulsor performance predictions.<br>- Continued development of two-phase flow waterjet concept, Detached Eddy Simulation (DES) method for crashback prediction and numerical prediction method(s) of waterjet cavitation.<br>- 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.<br>- Continued development of podded propulsor design/analysis tools.<br>- Continued prediction and validation of damaged stability and capsize. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued non-body-of-revolution tool development for advanced submarine configurations.<br>- Continued the multi-platform interaction analysis and tool development.<br>- Continued modeling of performance of composite propellers in extreme maneuvers.<br><br>Advanced Naval Power Systems:<br>- Continued demonstration of dynamic stability of an advanced intelligent, reconfigurable, solid-state-based, zonal-electrical power system that reconfigures within 10 milliseconds.<br>- Continued designing software for the system manager for the Universal Control Architecture (UCA).<br>- Continued development of thermal management technology for shipboard power distribution.<br>- Continued investigation of potential applications of silicon-carbide in future high voltage and high power applications.<br>- Continued improvements in electrical component and device technology allowing a reduction in motor propulsion and motor controllers weight and volume.<br>- Continued development of technologies to support dynamic reconfiguration of shipboard systems under conditions of stressing scenarios and/or system degradation.<br>- 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.<br>- Continued studies of alternative cooling systems for future shipboard radar systems.<br>- Continued control surface actuator project focused on the technologies needed to define the design space for control surface actuators supporting submarines.<br>- Continued development of automated HVAC system architectures for future Naval platforms.<br>- Continued development of common universal stator design to accommodate varying rotor topologies to improve affordability of motor design and development.<br>- Continued ship service fuel cell development.<br>- Continued development of shipboard waste heat driven chiller systems.<br>- Continued 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.<br>- Continued 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.<br>- Continued studies of advanced heating, ventilation, and air-conditioning architectures, including studies of alternative (nonvapor-compression) refrigeration systems and concepts for waste heat reuse, to enhance ship cooling and provide thermal energy storage. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued research into the development of fuel chemistries, materials, and energy conversion technologies for optimal performance in Naval power systems.<br>- Continued energy programs in support of SECNAV Energy Goals including biofuels, ship energy efficiencies and unmanned vehicle power systems.<br>- Continued effort to develop energy storage and conversion devices (e.g., batteries, capacitors, fuel cells) that are critical to many military missions.<br>- Continued effort to develop SIC power device with fast switching and ability to parallel devices for higher current.<br>- Continued development of robotic Hull BUG and coating technologies to reduce hull biofouling over current Navy operating conditions which will reduce drag and provide significant power/fuel/cost savings.<br>- Continued development of fuel cell components needed to make robust, compact, lightweight fuel cell systems for use in unmanned vehicles<br>- Continued development of low cost, light weight, flexible solar cells<br><br>Surface Ship & Submarine HM&E Applied Research:<br>- Continued to increase emphasis of the Science Advisor engagement within the joint S&T community across DOD, which will focus on addressing the operational and strategic needs of the Fleet.<br>- Increase emphasis of the Science Advisor engagement within the joint S&T community across DOD, which will focus on addressing the operational and strategic needs of the Fleet.<br>- Continued applied research into short-term motion forecasting for recovery in higher sea states.<br>- Continued applied research into determination of slamming loads on high-speed planing hulls for structural weight reduction.<br><br>Counter Improvised Explosive Devices<br>- Initiated efforts to expand counter-improvised explosive devices (C-IED) enhancement to support urgent operational needs. These included:<br>- Initiated research to analyze and understand enemy threat organizations and networks (both cultural networks and IT networks)<br>- Initiated research in directed energy weapons with the goal of reducing size, weight, and power requirements for systems in the detection and neutralization of IEDs.<br>- Initiated research in the mitigation of CIED effects (blast, blunt trauma, ballistics) on personnel.<br>***FY 2014 Plans:***<br>Survivable Platforms - Reduced Signatures<br>- Continue all efforts of FY 2013.<br><br>Survivable Platforms - Hull Life Assurance | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts of FY 2013.<br>- Complete development of reliability-based recoverability methods for assessing damaged ship structures.<br><br>Survivable Platforms - Distributed Intelligence for Automated Survivability<br>- Continue all efforts of FY 2013.<br><br>Advanced Platforms - Advanced Platform Concepts and Designs<br>- Continue all efforts of FY 2013.<br><br>Advanced Platforms - Hydromechanics<br>- Continue all efforts of FY 2013.<br><br>Advanced Naval Power Systems<br>- Continue all efforts of FY 2013.<br>- Complete effort to develop energy storage and conversion devices (e.g., batteries, capacitors, fuel cells) that are critical to many military misssions.<br>- Complete effort to develop SIC power device with fast switching and ability to parallel devices for higher current.<br><br>Surface Ship & Submarine HM&E Applied Research<br>- Continue all efforts of FY 2013.<br>- Initiate efforts to implement the results from hybrid composite blisters /appendages and their effect on ship drag resistance and fuel saving performance, motion and stability in ship models to verify computations and adapt shapes of appendages.<br>- Initiate the ONR Applied Research Challenge (ARC) to stimulate new, high-risk applied research projects in areas not currently addressed by the current ONR core applied research programs.<br><br>Advanced ASW Surveillance<br>-Initiate development of Long Endurance UUV technologies.<br><br>Counter Improvised Explosive Devices<br>- Started research in Route Reconnaissance and Clearance methodologies to provide standoff detection, neutralization, and marking of buried and surface laid, on and off route, pressure plate, command wire and radio frequency initiated explosive obstacles using directed energy and mechanical means on autonomous or semi autonomous platforms.<br>***FY 2015 Plans:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Survivable Platforms - Reduced Signatures:<br>- Continue all efforts of FY 2014.<br>- Continued utilization of condition-based maintenance systems for platform underwater signature assessment.<br>- Continued development of advanced analytical, numerical and experimental methods in support of platform acoustic signature reduction.<br>- Continued development of a prediction and monitoring of a surface ship propulsion system for underwater acoustic signatures.<br>- Continued development of global optimization of damped structures.<br><br>Survivable Platforms - Hull Life Assurance:<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Continue development of lightweight low-cost protection system for specific platforms for protection against specific large threats for the Explosion Resistant Coatings (ERC).<br>- Continue development of lightweight protection system for vehicles (MTVR) for protection against specific small arms and IEDs for the Explosion Resistant Coatings (ERC) program.<br>- Continue Ship modifications using blisters for application to DDG51 Flight III to gain larger displacement for AMDR and at the same time achieve higher fuel efficiency.<br><br>Survivable Platforms - Distributed Intelligence for Automated Survivability:<br>- Continue all efforts of FY 2014.<br><br>Advanced Platforms - Advanced Platform Concepts and Designs:<br>- Continue all efforts of FY 2014.<br><br>Advanced Platforms - Hydromechanics:<br>- Continue all efforts of FY 2014.<br>- Complete waterjet efforts, including two-phase waterjet development and RANS code development and validation efforts.<br>- Initiate cavitation erosion modeling on compliant surface.<br><br>Advanced Naval Power Systems:<br>- Continue all efforts of FY 2014, less those noted as completed above.<br><br>Surface Ship & Submarine HM&E Applied Research:<br>- Continue all efforts of FY 2014. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Counter Improvised Explosive Devices<br>- Continue all other efforts of FY 2014.<br>- Complete effort to develop transparent armor using flawless glass.<br>- Complete effort on the studies of antennas for high powered microwaves and radio frequency applications. | | | |
| ***Title:*** NAVAL RESEARCH ENTERPRISE | 3.900 | 4.328 | 4.467 |
| ***Description:*** The Naval Research Enterprise (NRE) encompasses the Independent Applied Research (IAR) efforts focused on solving a wide range of Naval Science and Technology (S&T) fleet issues utilizing unique Naval Warfare Center (WC) laboratory capabilities. Efforts under this activity address the full spectrum of the DON S&T Strategic Plan technology using focus areas which engage Naval aviation, sea surface, undersea, space, weapons, communication, information, and human systems. The IAR Program provides participating WCs with in-house funding for applied research to support the execution of their assigned missions by;<br>-Developing and maintaining a cadre of active researchers who can distill and extend results from worldwide research and apply them to solve Naval problems.<br>-Promoting the hiring and development of talented new scientists and engineers (S&E) with the insurance of proper mentoring with senior personnel<br>-Encouraging collaboration with universities, private industry, and other Navy and Department of Defense laboratories.<br><br>Funded projects are chosen through rigorous internal competition by each WC's selection committee and typically last two to three years. IAR projects are generally designed to promote investment in high-risk/high-payoff research and also allow young S&Es to manage Navy relevant research projects. A limited number of successful efforts developed under the In-House Laboratory Independent Research (ILIR) basic research Program Element 0601152N are matured and further developed under the IAR program with the goal of transitioning these technologies to the warfighter.<br><br>The IAR R2 activity was stood up in FY 2013 as the Naval Research Enterprise (NRE) to consolidate all NRE related IAR investments. Projects funded in this R2 Activity are intended to be approximately 2-3 years in length. Based on historical trends approximately 30% of these projects will turn over each year.<br><br>***FY 2013 Accomplishments:***<br>- Continued research for Unmanned Sensor Network Concepts for Counter-Surveillance and Explosive Hazard Detection by investigating autonomy with imperfect perception, sensor and signal processing techniques supporting autonomy and battlefield sensing missions, and Human-Machine Interaction (HMI). | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued research for Advanced Search and Tracking routines through the utilization and modification of advanced algorithms such as Maximum Likelihood Probabilistic Data Association Tracker (ML-PDA) and Moving-Source Matched Field Processing (MFP).<br>- Continued research for sensors and ultra-low/self-powered sensors for remote applications addressing sub-threshold hydrophones, undersea wireless networks, and communication networks.<br>- Continued research for advanced energetic materials with significantly enhanced explosive yields (over HMX) while improving insensitivity characteristics such as shock and thermal stabilities.<br>- Continued research for reduced drag on surface ship hull designs utilizing advanced computational analysis and hydrodynamic model testing addressing scaling effects due to non-dimensional parameters such as the Froude number.<br>- Completed research for the Mitigation of Acute and Chronic spinal pain in Naval Aircrew project by determining the efficacy of interventions to reduce neck and low back pain severity and incidence in a randomized controlled series of trials with U.S. Navy aircrew.<br>- Completed research for Mid- to Long-Wavelength Infrared Optical Emitter Sources for Chemicals and Explosives Detection through the development of a high-performance long-wavelength infrared tunable laser that would enable a significant increase in standoff detection.<br>- Completed research for Viscoelastic Materials Study for the Mitigation of Blast-Related Brain Injury where the investigation of viscoelastic polymers are identified for use as a helmet liner to protect the warfighter from exposure to blast pressure and reduce the incidence of blast-related Traumatic Brain Injury (TBI).<br>- Completed research for the Development of a Solid Propellant Burning Rate Model to optimize the performance of Navy missiles by addressing: surface decomposition of propellant ingredients, gas-phase diffusion rates, reaction kinetics, particle-size, and the effects of pressure and initial temperature.<br>- Initiated research for the repair and repair process of Navy aircraft and ship alloys such as titanium and high-strength low-alloy steels.<br>- Initiated research for warfighter performance predictions utilizing cognitive information and other human factors to enhance training experience and outcome.<br>- Initiated research for highly accurate autonomous unmanned undersea vehicles (UUV) communication and navigation. | | | |
| ***FY 2014 Plans:***<br>- Complete research for Unmanned Sensor Network Concepts for Counter-Surveillance and Explosive Hazard Detection by investigating autonomy with imperfect perception, sensor and signal processing techniques supporting autonomy and battlefield sensing missions, and Human-Machine Interaction (HMI).<br>- Complete research for Advanced Search and Tracking routines through the utilization and modification of advanced algorithms such as Maximum Likelihood Probabilistic Data Association Tracker (ML-PDA) and Moving-Source Matched Field Processing (MFP). | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete research for sensors and ultra-low/self-powered sensors for remote applications addressing sub-threshold hydrophones, undersea wireless networks, and communication networks.<br>- Complete research for advanced energetic materials with significantly enhanced explosive yields (over HMX) while improving insensitivity characteristics such as shock and thermal stabilities.<br>- Complete research for reduced drag on surface ship hull designs utilizing advanced computational analysis and hydrodynamic model testing addressing scaling effects due to non-dimensional parameters such as the Froude number.<br>- Initiate FY 2014 ILIR projects.<br>***FY 2015 Plans:***<br>- Complete research for the repair and repair process of Navy aircraft and ship alloys such as titanium and high-strength low-alloy steels.<br>- Complete research for warfighter performance predictions utilizing cognitive information and other human factors to enhance training experience and outcome.<br>- Complete research for highly accurate autonomous unmanned undersea vehicles (UUV) communication and navigation.<br>- Complete research on the effects of CMAS (Sand Dust) in Ceramic Matrix Composites (CMCs) to characterize CMAS and CMAS/salt effects in gas-turbine grade engine environments.<br>- Complete researchon the development and characterization of exploding ink.<br>- Complete research on advanced submarine air purification.<br>- Complete research on large-eddy simulations of advanced propulsion technology for UAV weapon systems.<br>- Complete research on a metamaterial-based buoyant cable antenna with non-uniform loading.<br>- Complete research of a bioluminescence system for submerged vehicles.<br>- Continue research for the repair and repair process of Navy aircraft and ship alloys such as titanium, high-strength low-alloy steels, composites, and metamaterials.<br>- Continue research for highly accurate autonomous unmanned undersea vehicles (UUV) communication and navigation.<br>- Inititate FY 2015 projects. | | | |
| **Accomplishments/Planned Programs Subtotals** | 128.494 | 145.288 | 139.496 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>0000 / *Force Protection Applied Res* |

**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. Efforts funded in this PE also include energy programs in support of SECNAV energy goals and efforts in support of the Ohio Replacement program.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 2 | R-1 Program Element (Number/Name)<br>PE 0602123N / *Force Protection Applied Res* | Project (Number/Name)<br>9999 / *Congressional Adds* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9999: *Congressional Adds* | - | 60.501 | 25.000 | - | - | - | - | - | - | - | - | 85.501 |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

Congressional Interest Items not included in other Projects.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 |
|---|---|---|
| ***Congressional Add:*** Alternative Energy Research | 36.483 | 25.000 |
| ***FY 2013 Accomplishments:*** FY13 Accomplishments include:<br>-Successful testing of Ion Tiger hydrogen powered fuel cell, and setting of UAV airborne endurance records of 48 hour using liquid hydrogen fuel.<br>-Successful evaluation of the Micro Auto-Gasification System (MAGS) waste management unit at MARFORPAC HQ and BALIKATAN joint Marine Corps - Philippine Military exercise.<br>-Successful evaluation of General Motors Equinox Fuel Cell Electric Vehicles (FCEVs) for non-tactical vehicle use at Naval Facilities.<br>-Continued heat exchanger material corrosion evaluation and continued process control evaluations for Ocean Thermal Energy Conversion (OTEC) systems.<br>-Continued development of sophisticated hydrodynamic tools for design of high performance, high efficiency hull forms for naval ships and craft.<br>-Continued evaluation of grid frequency control techniques using grid frequency response and battery state-of-charge algorithms and 1MW, 250kW-Hr advanced, fast response Lithium-Titanate battery system to demonstrate 40% reduction in frequency variability.<br>-Initiation of evaluation of external power operations using General Motors Equinox Fuel Cell Electric Vehicles (FCEVs) with off-board power (OBP) capability at Camp Pendleton.<br>-Initiation of evaluation of plasma flow control to improve wind turbine efficiency. | | |
| ***FY 2014 Plans:*** N/A | | |
| ***Congressional Add:*** Materials Research and Technology | 12.009 | - |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602123N / *Force Protection Applied Res* | **Project (Number/Name)**<br>9999 / *Congressional Adds* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 |
|---|---|---|
| ***FY 2013 Accomplishments:*** ONR Special Notice 13-SN-0020 to solicit research solutions for the two topics identified above was published on 17 Jun 2013. White papers are due on 25 Jul 2013, white paper feedback will be provided by 12 Sep 2013, and full proposals are due on 17 Oct 2013.<br>***FY 2014 Plans:*** N/A | | |
| ***Congressional Add:*** Power Generation and Storage Research<br>***FY 2013 Accomplishments:*** ONR intends to issue a Special Notice in the summer of 2013 to solicit research solutions in the areas of battery safety and power generation. ONR anticipates that white papers will be submitted in FY13 and that full proposals, proposal selection and award will be completed by June 2014. Funds that are applied to on-going efforts are expected to be obligated in late FY13 or early (Q1) FY14.<br>***FY 2014 Plans:*** N/A | 12.009 | - |
| **Congressional Adds Subtotals** | 60.501 | 25.000 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

Not applicable.

**E. Performance Metrics**

Congressional Interest Items not included in other Projects.

THIS PAGE INTENTIONALLY LEFT BLANK

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | **R-1 Program Element (Number/Name)**<br>PE 0602131M *I Marine Corps Lndg Force Tech* |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Program Element | 0.000 | 41.687 | 47.334 | 45.831 | - | 45.831 | 49.001 | 49.590 | 50.936 | 51.036 | Continuing | Continuing |
| 3001: *Marine Corps Landing Force Tech* | 0.000 | 41.687 | 47.334 | 45.831 | - | 45.831 | 49.001 | 49.590 | 50.936 | 51.036 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 (June 2012). 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. In the post-September 11 world, irregular warfare (IW) has emerged as the dominant form of warfare confronting the United States, its allies and its partners; accordingly, this PE has been structured to account for distributed, long-duration operations, including unconventional warfare, counterterrorism, counterinsurgency, and stabilization and reconstruction operations. IW emphasizes the use of indirect, non-conventional methods and means to subvert, attrite, and exhaust an adversary, or render irrelevant, rather than defeat him through direct conventional military confrontation. IW is now institutionalized in Marine Corps planning, investment, and capability development. 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, FORCEnet and Force Health Protection pillars, Space, Naval Expeditionary Maneuver Warfare and the Enterprise and Platform Enablers. The FNC program comprises Enabling Capabilities (ECs) which develop and deliver quantifiable products (i.e., prototype systems, knowledge products, and technology improvements) in response to validated requirements for insertion into acquisition programs of record after meeting agreed upon exit criteria within five years. 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). The Marine Corps Service Campaign Plan (MCSCP) is the lens through which USMC S&T priorities are acted upon to guide the future development of the Total Force.
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, RDT&E Budget Item Justification: PB 2015 Navy | | | | | Date: March 2014 |
|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | | | R-1 Program Element (Number/Name)<br>PE 0602131M *I Marine Corps Lndg Force Tech* | | |
| **B. Program Change Summary ($ in Millions)** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO** | **FY 2015 Total** |
| Previous President's Budget | 46.528 | 47.334 | 48.251 | - | 48.251 |
| Current President's Budget | 41.687 | 47.334 | 45.831 | - | 45.831 |
| Total Adjustments | -4.841 | - | -2.420 | - | -2.420 |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | - | - | | | |
| • SBIR/STTR Transfer | -0.960 | - | | | |
| • Rate/Misc Adjustments | 0.001 | - | -2.420 | - | -2.420 |
| • Congressional General Reductions Adjustments | -3.882 | - | - | - | - |

**Change Summary Explanation**

Technical: Not Applicable.

Schedule: Not Applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 2 | R-1 Program Element (Number/Name)<br>PE 0602131M / *Marine Corps Lndg Force Tech* | Project (Number/Name)<br>3001 / *Marine Corps Landing Force Tech* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3001: *Marine Corps Landing Force Tech* | - | 41.687 | 47.334 | 45.831 | - | 45.831 | 49.001 | 49.590 | 50.936 | 51.036 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** FIREPOWER | 4.146 | 4.854 | 4.942 |
| ***Description:*** 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.<br><br>***FY 2013 Accomplishments:***<br>- Continued development of a concept for an insensitive munitions propulsion system to enable firing a shoulder launched rocket from an enclosed space.<br>- Continued investigation of the scalability of variable effects conventional munitions technology for improving firepower effectiveness while increasing affordability and decreasing logistics burden in support of expeditionary warfare.<br>- Continued development of collaborative fires coordination technologies.<br>- Continued development of precision fires engagement technologies, to include trajectory shaped 81mm mortars.<br>- Continued expanded efforts in lightweight weapons and ammunition (crew served weapons, small arms ammunition, and packaging), to include Caseless (CL) Ammunition. This includes priority USMC fires efforts in Micro-electromechanical Systems (MEMS) Safe and Arm (S&A), to develop a Military Standard (MilStd) 1316 compliant S&A for incorporation into developmental precision 81mm mortar munitions and MEMS Initiation Safety Device (ISD), to develop MilStd 1901A compliant igniters for current and developmental weapons propulsion systems as well as a Revolutionary Target Effects project, to develop conventional warhead concepts for breaching specific urban targets.<br>- Continued Targeting & Engagement and Precision Target Location efforts that include Non-Magnetic Azimuth Sensing (NMAS) Technology. NMAS will continue to develop various technologies to achieve higher performance than previously possible while decreasing size and weight. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued design and development of lightweight technologies to provide individual Marines enhanced capabilities to detect and identify man-sized targets at least out to the maximum effective ranges of their individual weapons, during all conditions (daylight, limited visibility, & darkness), by integrating multiple optics capabilities into a single system.<br>- Continued E&D portion of NMAS technology development to reduce size, weight and power (SWaP) while increasing performance.<br>- Continued Hypervelocity Gun Propulsion project, to investigate hypervelocity gun technologies for Marine expeditionary weapons systems as possible artillery, tank main gun, and/or naval surface fire support replacement systems.<br>- Initiated Semi-Autonomous Fires Technology.<br>- Initiated Awareness for Lightweight Engagements and Remote Targeting (ALERT) to develop large aperture, lightweight lens with enhanced fields of view. | | | |
| ***FY 2014 Plans:***<br>- Continue all efforts from FY 2013, except those noted as completed.<br>- Continue development of a concept for an insensitive munitions propulsion system to enable firing a shoulder launched rocket from an enclosed space.<br>- Continue investigation of the scalability of variable effects conventional munitions technology for improving firepower effectiveness while increasing affordability and decreasing logistics burden in support of expeditionary warfare.<br>- Continue development of collaborative fires coordination technologies.<br>- Continue development of precision fires engagement technologies, to include trajectory shaped 81mm mortars.<br>- Continue expanded efforts in lightweight weapons and ammunition (crew served weapons, small arms ammunition, and packaging), to include Caseless (CL) Ammunition. This includes priority USMC fires efforts in Micro-electromechanical Systems (MEMS) Safe and Arm (S&A), to develop a Military Standard (MilStd) 1316 compliant S&A for incorporation into developmental precision 81mm mortar munitions and MEMS Initiation Safety Device (ISD), to develop MilStd 1901A compliant igniters for current and developmental weapons propulsion systems as well as a Revolutionary Target Effects project, to develop conventional warhead concepts for breaching specific urban targets.<br>- Continue Targeting & Engagement and Precision Target Location efforts that include Non-Magnetic Azimuth Sensing (NMAS) Technology. NMAS will continue to develop various technologies to achieve higher performance than previously possible while decreasing size and weight.<br>- Continue design and development of lightweight technologies to provide individual Marines enhanced capabilities to detect and identify man-sized targets at least out to the maximum effective ranges of their individual weapons, during all conditions (daylight, limited visibility, & darkness), by integrating multiple optics capabilities into a single system.<br>- Continue E&D portion of NMAS technology development to reduce size, weight and power (SWaP) while increasing performance. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Hypervelocity Gun Propulsion project, to investigate hypervelocity gun technologies for Marine expeditionary weapons systems as possible artillery, tank main gun, and/or naval surface fire support replacement systems.<br>- Continue Semi-Autonomous Fires Technology.<br>- Continue Awareness for Lightweight Engagements and Remote Targeting (ALERT) to develop large aperture, lightweight lens with enhanced fields of view.<br>- Initiate Azimuth and Inertial Micro-electromechanical System (MEMS) Navigation System (AIM) to develop low cost, precision, inertial navigation systems for use in highly accurate handheld targeting systems, shoulder launched missiles, and munitions.<br>- Initiate Caseless, Lightweight, Low-volume Round (CLLVR) to develop lightweight, small caliber ammunition for individual, crew served, and remotely mounted weapons.<br>- Initiate Advanced Sensors Applications (ASA) to develop Short Wave Infrared (SWIR) imagers for guided munitions seekers.<br>- Initiate Disruptive Energetic Materials (DEM) to exploit nano-energetics developments for significant enhancement of explosive yield per warhead mass and volume. | | | |
| ***FY 2015 Plans:***<br>- Continue development of a concept for an insensitive munitions propulsion system to enable firing a shoulder launched rocket from an enclosed space.<br>- Continue investigation of the scalability of variable effects conventional munitions and gun technology for improving firepower effectiveness while increasing affordability and decreasing logistics burden in support of expeditionary warfare.<br>- Continue development of precision fires engagement technologies, to include trajectory shaped 81mm mortars, 83mm missiles, and smaller precision munitions.<br>- Continue design and development of lightweight technologies to provide individual Marines enhanced capabilities to detect and identify man-sized targets at least out to the maximum effective ranges of their individual weapons, during all conditions (daylight, limited visibility, & darkness), by integrating multiple optics capabilities into a single system.<br>- Continue Semi-Autonomous Fires Technology.<br>- Continue Awareness for Lightweight Engagements and Remote Targeting (ALERT) to develop large aperture, lightweight lens with enhanced fields of view.<br>- Continue Azimuth and Inertial Micro-electromechanical System (MEMS) Navigation System (AIM) to develop low cost, precision, inertial navigation systems for use in highly accurate handheld targeting systems, shoulder launched missiles, and munitions.<br>- Continue Caseless, Lightweight, Low-volume Round (CLLVR) to develop lightweight, small caliber ammunition for individual, crew served, and remotely mounted weapons.<br>- Continue Disruptive Energetic Materials (DEM) to exploit nano-energetics developments for significant enhancement of explosive yield per warhead mass and volume.<br>- Complete development of collaborative fires coordination technologies. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete expanded efforts in lightweight weapons and ammunition (crew served weapons, small arms ammunition, and packaging), to include Caseless (CL) Ammunition. This includes priority USMC fires efforts in Micro-electromechanical Systems (MEMS) Safe and Arm (S&A), to develop a Military Standard (MilStd) 1316 compliant S&A for incorporation into developmental precision 81mm mortar munitions and MEMS Initiation Safety Device (ISD), to develop MilStd 1901A compliant igniters for current and developmental weapons propulsion systems as well as a Revolutionary Target Effects project, to develop conventional warhead concepts for breaching specific urban targets.<br>- Complete USMC fires efforts in MEMS Safe and Arm (S&A), to develop a Military Standard (MilStd) 1316 compliant S&A for incorporation into developmental precision 81mm mortar munitions and MEMS Initiation Safety Device (ISD), to develop MilStd 1901A compliant igniters for current and developmental weapons propulsion systems.<br>- Complete Revolutionary Target Effects project, to develop conventional warhead concepts for breaching specific urban targets.<br>- Complete Targeting & Engagement and Precision Target Location efforts that include Non-Magnetic Azimuth Sensing (NMAS) Technology by transitioning to the AIM Future Naval Capability project.<br>- Complete (E&D) portion of NMAS Technology development to reduce size, weight and power (SWaP) while increasing performance by transitioning to the AIM Future Naval Capability project.<br>- Complete Hypervelocity Gun Propulsion project, to investigate hypervelocity gun technologies for Marine expeditionary weapons systems as possible artillery, tank main gun, and/or naval surface fire support replacement systems.<br>- Complete Advanced Sensors Applications (ASA) to develop Short Wave Infrared (SWIR) imagers for guided munitions seekers. | | | |
| ***Title:*** FORCE PROTECTION | 4.585 | 5.377 | 5.472 |
| ***Description:*** This activity supports the Force Protection Thrust's applied research program. Technologies are being developed that focus on the following: Explosive Hazard avoidance, detection, breaching/neutralization, marking and analysis; Air Defense/ Counter Rocket, Artillery, and Mortars; Counter tactical surveillance and targeting, and technologies for improved protection for individuals including Marine Personnel Protective Equipment against blast, ballistic and blunt impact threats.<br><br>***FY 2013 Accomplishments:***<br>- Continued development of technologies for stand-off detection and neutralization of mines, IEDs, and Unexploded Ordnance (UXO) (Transitioned from Maneuver activity).<br>- Continued multi-spectral protection efforts against battlefield directed energy weapons.<br>- Continued development of technologies to defeat side/top attack and advanced mine fuzes (seismic, acoustic, and infrared) through advanced signature reduction, duplication, and projection (Transitioned from Maneuver activity).<br>- Continued spectral signature classification efforts for Mine Counter Measure (MCM) applications (Transitioned from Maneuver activity).<br>- 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. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued technology development programs to address force protection personal protective equipment capability gaps (Transitioned from Maneuver activity).<br>- Continued development of technologies to defeat advanced mine fuzes (seismic, acoustic, and infrared) (Transitioned from Maneuver activity).<br>- Continued 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.<br>- Continued 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.<br>- Continued 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.<br>- Continued technology development efforts to detect and defeat incoming rocket, artillery, and mortar threats via non-kinetic means.<br>- Continued a study of automated human detection via spectral imaging during low-light level operation conditions (e.g. dusk/ dawn/moonlit/starlit night) that was initiated in FY 2011 due to operational urgency.<br>- Continued the development of technologies that will detect and classify optics (sniper scopes, ccds, eyeball, etc) from a moving platform from an effort that was initiated in FY 2011 due to an urgent operational need.<br>- Continued the development of technologies that will detect Rocket Propelled Grenades (RPGs) and Anti-Tank Guided Missiles (ATGMs) prior to launch, and countermeasures after launch from a new effort that was initiated in FY 2011 due to operational urgency.<br>- Continued the demonstration of the feasibility of a deployable mission package consisting of technologies capable of screening multiple individuals rapidly over a wide area to detect, classify and track suicide bombers at relevant distances within a critical time frame. Due to an urgent Naval operational need, this effort was initiated in FY 2011.<br>- Continued a scientific study of laser technology readiness, performing technology roadmapping, and conducting system level simulations. This effort was initiated in FY 2011 due to an urgent operational need. This effort continues in FY 2012 and will assess the suitability of lasers on the battlefield and drive future HEL technology investment plans and support the acquisition process.<br>- Continued studies of sensor fields to identify and classify mine threats. This effort was planned for initiation in FY 2011 but was delayed due to emerging higher priority requirements.<br>- Completed studying the feasibility of detecting and locating sniper weapons using the return of their unique radar signatures. | | | |
| ***FY 2014 Plans:***<br>- Continue all efforts from FY 2013, except those noted as completed.<br>- Continue development of technologies for stand-off detection and neutralization of mines, IEDs, and Unexploded Ordnance (UXO) (Transitioned from Maneuver activity). | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue development of technologies to defeat side/top attack and advanced mine fuzes (seismic, acoustic, and infrared) through advanced signature reduction, duplication, and projection (Transitioned from Maneuver activity).<br>- Continue 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.<br>- Continue technology development programs to address force protection personal protective equipment capability gaps. (Transitioned from Maneuver activity).<br>- Continue the demonstration of the feasibility of a deployable mission package consisting of technologies capable of screening multiple individuals rapidly over a wide area to detect, classify and track suicide bombers at relevant distances within a critical time frame. Due to an urgent Naval operational need, this effort was initiated in FY 2011.<br>- Continue a scientific study of laser technology readiness, performing technology roadmapping, and conducting system level simulations. This effort was initiated in FY 2011 due to an urgent operational need. This effort continues in FY 2012 and will assess the suitability of lasers on the battlefield and drive future HEL technology investment plans and support the acquisition process.<br>- Complete spectral signature classification efforts for MCM applications (Transitioned from Maneuver activity).<br>- Complete 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.<br>- Complete technology development efforts to detect and defeat incoming rocket, artillery, and mortar threats via non-kinetic means.<br>- Complete multi-spectral protection efforts against battlefield directed energy weapons.<br>- Complete a study of automated human detection via spectral imaging during low-light level operation conditions (e.g. dusk/dawn/ moonlit/starlit night).<br>- Complete the development of technologies that will detect and classify optics (sniper scopes, ccds, eyeball, etc.) from a moving platform.<br>- Complete the development of technologies that will detect Rocket Propelled Grenades (RPGs) and Anti-Tank Guided Missiles (ATGMs) prior to launch, and countermeasures after launch.<br>- Complete development of technologies to defeat advanced mine fuzes (seismic, acoustic, and infrared) (Transitioned from Maneuver activity).<br>- Complete studies of sensor fields to identify and classify mine threats.<br>- Complete 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.<br>- Complete 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.<br>- Complete development and demonstrate technologies that will detect RPGs and ATGMs prior to launch and countermeasures after launch. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate a program to determine the feasibility to detect and neutralize anti-helicopter mine threat.<br>- Initiate the refinement and improve current suite of advanced biomechanical instrumentation to assess potential reductions of Warfighter mobility and functionality caused by PPE systems.<br>- Initiated the scientific investigation into an integrated PPE performance tool for assessing coordinated human and armor performance (mobility, back-face deformation, area of coverage, propensity for injury and mass).<br>***FY 2015 Plans:***<br>- Continue development of technologies for stand-off detection and neutralization of mines, IEDs, and Unexploded Ordnance (UXO) (Transitioned from Maneuver activity).<br>- Continue development of technologies to defeat side/top attack and advanced mine fuzes (seismic, acoustic, and infrared) through advanced signature reduction, duplication, and projection (Transitioned from Maneuver activity).<br>- Continue technology development programs to address force protection personal protective equipment capability gaps (Transitioned from Maneuver activity).<br>- Continued 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.<br>- Continue the development of technologies that will detect and classify optics (sniper scopes, ccds, eyeball, etc) from a moving platform from an effort that was initiated in FY 2011 due to an urgent operational need.<br>- Continue a program to determine the feasibility to detect and neutralize anti-helicopter mine threat.<br>- Continue the refinement and improve current suite of advanced biomechanical instrumentation to assess potential reductions of Warfighter mobility and functionality caused by PPE systems.<br>- Continue the scientific investigation into an integrated PPE performance tool for assessing coordinated human and armor performance (mobility, back-face deformation, area of coverage, propensity for injury and mass).<br>- Complete a study regarding the feasibility of detecting and locating sniper weapons using the return of their unique radar signatures that was initiated in FY 2011 due to operational urgency.<br>- Complete spectral signature classification efforts for Mine Counter Measure (MCM) applications (Transitioned from Maneuver activity).<br>- Complete the demonstration of the feasibility of a deployable mission package consisting of technologies capable of screening multiple individuals rapidly over a wide area to detect, classify and track suicide bombers at relevant distances within a critical time frame.<br>- Complete a scientific study of laser technology readiness, performing technology roadmapping, and conducting system level simulations. This effort was initiated in FY 2011 due to an urgent operational need. This effort continues in FY 2012 and will assess the suitability of lasers on the battlefield and drive future HEL technology investment plans and support the acquisition process.<br>- Initiate program to study the fundamental sciences of homemade explosives due to urgent operational needs. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate broad based material (ceramics, fiber and Fiber Re-Enforced Plastics) studies so that significant weight reductions (greater than 50%) can be achieved.<br>- Initiate broad based material (ceramics, fiber and Fiber Re-Enforced Plastics) studies so that significant weight reductions (greater than 50%) can be achieved.<br>- Initiate studies to improve ballistic and blast armor material and systems models so that novel concepts can be evaluated and material property characteristics which provide the necessary improvements can be identified prior to significant monetary investments.<br>- Initiate modeling and simulation efforts for the Warfighter-as-a-System analysis approach and methodology combining survivability, mobility, and warfighter performance parameters." | | | |
| ***Title:*** FUTURE CONCEPTS, TECHNOLOGY ASSESSMENT, AND ROADMAPPING | 1.165 | 1.368 | 1.402 |
| ***Description:*** 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.<br><br>***FY 2013 Accomplishments:***<br>- Continued assessments in Lightening the Marine's Load and Enhancing the Capabilities of the Marine Corps Rifle Squad.<br>- Continued assessments in Asymmetric/Irregular Warfare and Distributed Operations.<br>- Continued planning and integration of technology development efforts to meet imposing security threats that challenge our Nation.<br>- Continued an assessment of the S&T impacts of the Marine Corps concept of force employment to meet the need for counterinsurgency and building partnership capacity. How the Marine Corps will support the National Defense Strategy (NDS) and multinational efforts in the Global War on Terrorism/Long War will have long-term S&T impacts.<br>- Continued a Cargo Unmanned Aerial study focused on Ship-to-Objective Maneuver (STOM) and developmental technologies for expeditionary operations, to include ground autonomous capabilities.<br>- Initiated an assessment of Unmanned Ground Systems Affordability, Experimentation and Rapid Prototyping Investments and formulating a USMC S&T future strategy. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiated an effort focused on the suitability of lasers on the battlefield and formulating future High Energy Laser technology investment plans that support the acquisition process.<br>- Initiated an assessment of DoD-Wide programs to increase individual resiliency training throughout unit forming, training, deployment and post deployment phases. The objective is to provide the best skills and tools available to Marines and their leaders so that they can better cope with the challenges of combat and the rigor of life as a Marine, both deployed and in garrison.<br>***FY 2014 Plans:***<br>- Continue all efforts from FY 2013, except those noted as completed.<br>- Continued planning and integration of technology development efforts to meet imposing security threats that challenge our Nation.<br>- Continue assessments in Lightening the Marine's Load and Enhancing the Capabilities of the Marine Corps Rifle Squad.<br>- Complete assessments in Asymmetric/Irregular Warfare and Distributed Operations.<br>- Complete an assessment of the S&T impacts of the Marine Corps concept of force employment to meet the need for counterinsurgency and building partnership capacity. How the Marine Corps will support the National Defense Strategy (NDS) and multinational efforts in the Global War on Terrorism/Long War will have long-term S&T impacts.<br>- Complete a Cargo Unmanned Aerial study focused on Ship-to-Objective Maneuver (STOM) and developmental technologies for expeditionary operations, to include ground autonomous capabilities.<br>- Complete an assessment of Unmanned Ground Systems Affordability, Experimentation and Rapid Prototyping Investments and formulating a USMC S&T future strategy.<br>- Complete an effort focused on the suitability of lasers on the battlefield and formulating future High Energy Laser technology investment plans that support the acquisition process.<br>- Initiate a careful analysis of trends that can identify emerging changes in the security environment that are likely to have significant implications for U.S. ground forces. The output will be used to reduce risk and hedge against the surprises that will inevitably occur.- -<br>- Continued an assessment of DoD-Wide programs to increase individual resiliency training throughout unit forming, training, deployment and post deployment phases. The objective is to provide the best skills and tools available to Marines and their leaders so that they can better cope with the challenges of combat and the rigor of life as a Marine, both deployed and in garrison.<br>***FY 2015 Plans:***<br>- Continue planning and integration of technology development efforts to meet imposing security threats that challenge our Nation.<br>- Complete assessments in Lightening the Marine's Load and Enhancing the Capabilities of the Marine Corps Rifle Squad.<br>- Complete assessments in Asymmetric/Irregular Warfare and Distributed Operations.<br>- Complete an assessment of the S&T impacts of the Marine Corps concept of force employment to meet the need for counterinsurgency and building partnership capacity. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete a Cargo Unmanned Aerial study focused on Ship-to-Objective Maneuver (STOM) and developmental technologies for expeditionary operations, to include ground autonomous capabilities.<br>- Complete an assessment of Unmanned Ground Systems Affordability, Experimentation and Rapid Prototyping Investments and formulate a USMC S&T future strategy.<br>- Complete an effort focused on the suitability of lasers on the battlefield and formulate future High Energy Laser technology investment plans that support the acquisition process.<br>- Initiate a careful analysis of trends that can identify emerging changes in the security environment that are likely to have significant implications for U.S. ground forces. The output will be used to reduce risk and hedge against the surprises that will inevitably occur.<br>- Initiate a technology assessment for a Cyber/Electronic Warfare Coordination Cell (CEWCC) to enable seamless integration of kinetic and non-kinetic fires during expeditionary operations. | | | |
| ***Title:*** HUMAN PERFORMANCE, TRAINING AND EDUCATION | 4.185 | 4.900 | 4.992 |
| ***Description:*** This activity addresses the applied research effort of the Human Performance Training and Education thrust (HPT&E). The HPT&E thrust investment profile is directed at two technology investment areas, Warrior Resilience, and Decision Making and Expertise Development. The funding aligned to Warrior Resilience is focused on advanced training technologies and methodologies that enhance neural, cognitive, and physical readiness. Those funds aligned to Decision Making and Expertise Development refers to training and education technologies and methodologies that accelerate the development and improve the retention of skills in decision making, situation awareness, and individual and team adaptability and coordination on decentralized, dynamic and dispersed battlefields. | | | |
| ***FY 2013 Accomplishments:***<br>- Completed development of field team performance mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise.<br>- Continue research into acclimatization parameters to enhance warfighter performance. This effort initiated in FY 2011 due to urgent operational needs<br>- Continued research into heat stress mitigations for the individual warfighter to develop intervention strategies to improve performance in hot environments.<br>- Continued research into distributed mobile architectures to support US Marine Corps training.<br>- Completed feasibility research into mobile field technologies for predicting readiness and performance.<br>- Completed 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. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Completed additional Human Performance and Training efforts (Cognitive and physical enhancement, modeling and simulation, and virtual reality squad level training in support of Distributed Operations).<br>- Completed additional efforts to incorporate effects of nutrition and functional fitness into models and simulations in the Distributed Operations Virtual Toolkit.<br>- Completed 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.<br>- Completed 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.<br>- Completed studies into next generation physical performance enhancement methodologies and technologies (enhanced warfighter psycho-physical performance).<br>- Completed research to evaluate the feasibility of integrating augmented reality technologies into current and emerging training systems (Smart Tutoring Systems).<br>- Completed research investigating the feasibility of identifying EEG markers of language learning and attentional flexibility, and incorporate into adaptive training protocols (Neuroadaptive Language Training). This effort was initiated in FY 2010.<br>- Completed evaluations of asymmetric distributed learning techniques for distributed operations, language, and cultural training.<br>- Continued development of team training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise.<br>- Completed development of team training/immersive approaches towards language and culture training that incorporate foundational learning theories and other advanced educational methods.<br>- Completed development of squad-level team training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise.<br>- Initiated research into cold tolerance biomarkers for the individual warfighter.<br>- Initiated research into Acclimatization Strategies for Optimized Performance at Altitude, drawing on findings from previous research done in the field.<br>- Initiated research into mobile brain imaging to enhance warfighter performance.<br>- Initiated research into haptic solutions for immersive training environments.<br>- Initiated research into skills retention technologies, advancing the Smart Tutoring System.<br>- Initiated research into tools for distributed training (trend analysis).<br>***FY 2014 Plans:***<br>- Continue all efforts from FY 2013, except those noted as completed.<br>- Complete research into acclimatization parameters to enhance warfighter performance. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete research into heat stress mitigations for the individual warfighter, and develop intervention strategies to improve performance in hot environments.<br>- Complete research into distributed mobile architectures to support US Marine Corps training.<br>- Complete research to improve nutritional optimization strategies for enhancing performance of warfighters.<br>- Complete research into cold tolerance biomarkers for the individual warfighter.<br>- Complete research into Acclimatization Strategies for Optimized Performance at Altitude, drawing on findings from previous research done in the field.<br>- Complete research into mobile brain imaging to enhance warfighter performance.<br>- Complete research into haptic solutions for immersive training environments.<br>- Complete research into skills retention technologies, advancing the Smart Tutoring System.<br>- Complete research into tools for distributed training (trend analysis).<br>- Complete research into haptic solutions for immersive training environments.<br>- Initiate research into a multi-modal framework for assessing stress resiliency; develop, test and evaluate non-contact, video and audio-based human response measures for use in detecting degree and type of stress for eventual integration into a resiliency training program.<br>- Initiate research into the architecture for stress, performance, inoculation, resilience, and endurance (ASPIRE); development of an inductive framework of stressors, stress proneness, and stress resilience, while also building an actionable, deductive counterpart of these stress variables that will ultimately include an operational taxonomy of stress resilience components, combined with an integrated stress resilience framework.<br>- Initiate research into methodologies for assessing training and for training adaptability, identifying key salient components of adaptive behavior for Warfighter tactical tasks; research into the development of a generalized framework for adaptive behavior that can be applied to any appropriate tactical task, and the creation of methodologies for training interventions that demonstrates the feasibility of using virtual training experiences to accelerate the development of adaptive decision-making expertise.<br>***FY 2015 Plans:***<br>- Continue studies into next generation physical performance enhancement methodologies and technologies (enhanced warfighter psycho-physical performance).<br>- Continue research to evaluate the feasibility of integrating augmented reality technologies into current and emerging training systems.<br>- Continue 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. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete research into a multi-modal framework for assessing stress resiliency; develop, test and evaluate non-contact, video and audio-based human response measures for use in detecting degree and type of stress for eventual integration into a resiliency training program.<br>- Complete research into methodologies for assessing training and for training adaptability, identifying key salient components of adaptive behavior for Warfighter tactical tasks; research into the development of a generalized framework for adaptive behavior that can be applied to any appropriate tactical task, and the creation of methodologies for training interventions that demonstrates the feasibility of using virtual training experiences to accelerate the development of adaptive decision-making expertise.<br>- Complete evaluations of asymmetric distributed learning techniques for distributed operations, language, and cultural training.<br>- Complete additional Human Performance and Training efforts (Cognitive and physical enhancement, modeling and simulation, and virtual reality squad level training in support of Distributed Operations).<br>- Complete 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.<br>- Complete 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.<br>- Complete additional efforts to incorporate effects of nutrition and functional fitness into models and simulations in the Distributed Operations Virtual Toolkit.<br>- Complete development of team training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise.<br>- Complete development of team training/immersive approaches towards language and culture training that incorporate foundational learning theories and other advanced educational methods.<br>- Complete development of squad-level team training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise.<br>- Complete development of field team performance mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise.<br>- Complete research into cold tolerance biomarkers for the individual warfighter.<br>- Complete research into Acclimatization Strategies for Optimized Performance at Altitude, drawing on findings from previous research done in the field.<br>- Complete research into mobile brain imaging to enhance warfighter performance.<br>- Complete research into haptic solutions for immersive training environments.<br>- Complete research into skills retention technologies, advancing the Smart Tutoring System.<br>- Complete research into tools for distributed training (trend analysis).<br>- Complete research into the architecture for stress, performance, inoculation, resilience, and endurance (ASPIRE); development of an inductive framework of stressors, stress proneness, and stress resilience, while also building an actionable, deductive | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| counterpart of these stress variables that will ultimately include an operational taxonomy of stress resilience components, combined with an integrated stress resilience framework.<br>- Initiate research into the effects of glucose administration to mitigate stress reactions in trauma patients. This effort initiated in FY 2014 due to urgent operational requirements.<br>- Initiate design and development of an automated functional movement screening system to provide a low cost accurate solution for fit-for-duty evaluations and injury prevention training. This effort initiated in FY 14 due to urgent operational requirements.- Initiate development of statistical methods for measuring small unit decision making (SUDM), using previous work on developing assessments of small unit decision making (e.g., Levels of Mastery), and provide a series of training sessions on statistical modeling to enable ground work to be laid by SUDM projects to also use statistical modeling. This effort initiated in FY 2014 due to urgent operational requirements. | | | |
| ***Title:*** INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR) | 2.404 | 2.799 | 2.844 |
| ***Description:*** 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 biometrics for expeditionary operations, complete future automation of options and persistent surveillance in support of distributed operations.<br><br>***FY 2013 Accomplishments:***<br>- Continued development of information fusion technologies to allow automated construction of a common tactical picture from various sources of sensor data.<br>- Continued development of low power consumption urban sensing technologies.<br>- Continued development of tagging, tracking and locating technologies to monitor adversary movement.<br>- Continued development of information on demand technologies to provide the warfighter with the right information at the right time.<br>- Continued development of urban sensing technologies to detect weapons at distance.<br>- Continued development of advanced tactical sensor technologies to improve unit awareness.<br>- Continued development of distributed information architecture technologies.<br>- Continued development of a single, integrated, battlespace picture with tactical and strategic injections that begins to close the gap between ISR and C2.<br>- Continued Actionable Intelligence for Expeditionary and Irregular Warfare effort which includes real-time methods for Identifying Human Networks. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of advanced tactical nets to include additional phenomenologies and the netting of C2, Sensors and Analysis nodes.<br>- Continued efforts addressing "battlespace awareness" of human networks, improving the accuracy of classification decisions and enabling a human network predictive capability. Once a human network sensor 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 sensors. When combined, research into human network awareness, network classification and network prediction, will be a powerful tool for warfare against the irregular actor.<br>- Continued development of adaptable enemy course of action engine to manipulate adversary decisions.<br>- Continued efforts to track entities of interest in a high clutter environment via geolocation of optical tags from a UAV platform.<br>- Continued 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.<br>- Continued 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.<br>- Continued development of sensors that provide near-real-time decision support to distributed operations by detecting specific interactions utilizing nanotechnology.<br>- Continued efforts to derive high resolution models of human networks statistically, with associated behavior attributes.<br>- Continued work on specific nanomaterial triggers and receptors.<br>- Continued work on new optical taggants with improved producibility.<br>- Continued work on influencing, disrupting, and stimulating behavior by fusing high resolution models of decisions with models of human networks. This includes work to provide an accurate decision tool to the warfighter that is relevant to irregular warfare, and development of tools to enable robust facial recognition in poor conditions and difficult environments.<br>- Continued development of model based adversarial decision making stimulus and manipulation that will assist in the influence of decisions made by adversaries to our benefit.<br>- Completed 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<br>- Initiated research in automated techniques to establish the reliability of data from human and machine sources.<br>- Initiated technology development efforts required to enable a lightweight hyperspectral sensor capable of material characterization.<br>- Initiated research on the development of networked, ultra low power, long life and smart ground sensors. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiated research to develop algorithms that can disambiguate complex network graphs containing millions of sparsely characterized nodes.<br>.<br>***FY 2014 Plans:***<br>- Continue all efforts from FY 2013, except those noted as completed.<br>- Continue development of information fusion technologies to allow automated construction of a common tactical picture from various sources of sensor data.<br>- Continue development of low power consumption urban sensing technologies.<br>- Continue development of tagging, tracking and locating technologies to monitor adversary movement.<br>- Continue development of information on demand technologies to provide the warfighter with the right information at the right time.<br>- Continue development of distributed information architecture technologies.<br>- Continue development of a single, integrated, battlespace picture with tactical and strategic injections that begins to close the gap between ISR and C2.<br>- Continue development of advanced tactical nets to include additional phenomenologies and the netting of C2, Sensors and Analysis nodes.<br>- Continue efforts addressing "battlespace awareness" of human networks, improving the accuracy of classification decisions and enabling a human network predictive capability. Once a human network sensor 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 sensors. When combined, research into human network awareness, network classification and network prediction, will be a powerful tool for warfare against the irregular actor.<br>- Continue 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.<br>- Continue 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.<br>- Continue development of sensors that provide near-real-time decision support to distributed operations by detecting specific interactions utilizing nanotechnology.<br>- Continue efforts to derive high resolution models of human networks statistically, with associated behavior attributes.<br>- Continue work on influencing, disrupting, and stimulating behavior by fusing high resolution models of decisions with models of human networks. This includes work to provide an accurate decision tool to the warfighter that is relevant to irregular warfare, and development of tools to enable robust facial recognition in poor conditions and difficult environments. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue development of model based adversarial decision making stimulus and manipulation that will assist in the influence of decisions made by adversaries to our benefit.<br>- Continue research in automated techniques to establish the reliability of data from human and machine sources.<br>- Continue technology development efforts required to enable a lightweight hyperspectral sensor capable of material characterization.<br>- Continue research on the development of networked, ultra low power, long life and smart ground sensors.<br>- Continue research to develop algorithms that can disambiguate complex network graphs containing millions of sparsely characterized nodes.<br>- Complete development of urban sensing technologies to detect weapons at distance.<br>- Complete development of advanced tactical sensor technologies to improve unit awareness.<br>- Complete development of adaptable enemy course of action engine to manipulate adversary decisions.<br>- Complete work on specific nanomaterial triggers and receptors.<br>- Complete work on new optical taggants with improved producibility.<br>- Complete Actionable Intelligence for Expeditionary and Irregular Warfare effort which includes real-time methods for Identifying Human Networks.<br>- Complete efforts to track entities of interest in a high clutter environment via geolocation of optical tags from a UAV platform.<br>- Initiate development of advanced analytics (data disambiguation, conditioning, fusion and dissemination) as a set of map reduce tasks that can run across a highly distributed data architecture.<br>- Initiate development of own force decision aids based on imprecisely-specified multi-attribute utility theory.<br>- Initiate the development of automated workflow managers enabled by the semantic representation of tasks and resources. | | | |
| ***FY 2015 Plans:***<br>- Continue development of information fusion technologies to allow automated construction of a common tactical picture from various sources of sensor data.<br>- Continue development of low power consumption urban sensing technologies.<br>- Continue development of tagging, tracking and locating technologies to monitor adversary movement.<br>- Continue development of information on demand technologies to provide the warfighter with the right information at the right time.<br>- Continue development of urban sensing technologies to detect weapons at distance.<br>- Continue development of advanced tactical sensor technologies to improve unit awareness.<br>- Continue development of distributed information architecture technologies.<br>- Continue development of a single, integrated, battlespace picture with tactical and strategic injections that begins to close the gap between ISR and C2. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Actionable Intelligence for Expeditionary and Irregular Warfare effort which includes real-time methods for Identifying Human Networks.<br>- Continue efforts addressing "battlespace awareness" of human networks, improving the accuracy of classification decisions and enabling a human network predictive capability. Once a human network sensor 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 sensors. When combined, research into human network awareness, network classification and network prediction, will be a powerful tool for warfare against the irregular actor.<br>- Continue development of adaptable enemy course of action engine to manipulate adversary decisions.<br>- Continue efforts to track entities of interest in a high clutter environment via geolocation of optical tags from a UAV platform.<br>- Continue 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.<br>- Continue efforts to derive high resolution models of human networks statistically, with associated behavior attributes.<br>- Continue work on specific nanomaterial triggers and receptors.<br>- Continue work on new optical taggants with improved producibility.<br>- Continue research in automated techniques to establish the reliability of data from human and machine sources.<br>- Continue technology development efforts required to enable a lightweight hyperspectral sensor capable of material characterization.<br>- Continue research on the development of networked, ultra low power, long life and smart ground sensors.<br>- Continue research to develop algorithms that can disambiguate complex network graphs containing millions of sparsely characterized nodes.<br>- Continue development of advanced analytics (data disambiguation, conditioning, fusion and dissemination) as a set of map reduce tasks that can run across a highly distributed data architecture.<br>- Complete development of advanced tactical nets to include additional phenomenologies and the netting of C2, Sensors and Analysis nodes.<br>- Complete 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.<br>- Complete 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.<br>- Complete development of sensors that provide near-real-time decision support to distributed operations by detecting specific interactions utilizing nanotechnology. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete work on influencing, disrupting, and stimulating behavior by fusing high resolution models of decisions with models of human networks. This includes work to provide an accurate decision tool to the warfighter that is relevant to irregular warfare, and development of tools to enable robust facial recognition in poor conditions and difficult environments.<br>- Complete development of model based adversarial decision making stimulus and manipulation that will assist in the influence of decisions made by adversaries to our benefit.<br>- Complete development of own force decision aids based on imprecisely-specified multi-attribute utility theory.<br>- Complete the development of automated workflow managers enabled by the semantic representation of tasks and resources.<br>- Initiate research in analytics for limited and isolated computational environments to enable advanced analytic capabilities to be available on expeditionary lightweight computing platforms.<br>- Initiate research on the automated deconfliction and fusion of multi-intelligence tracks on movers of interest, enabled by a rich maritime ontology and active wiki technology.<br>- Initiate research on the technologies needed to develop a sensor/force and analytic task planner informed by real time predictive analysis for power restricted cells.<br>- Initiate research on technologies needed to produce products from multi-modal information in response to information requirements by leveraging cloud data access capabilities.<br>- Initiate research on technologies needed to tailor information delivery to warfighters based on mission context and user preferences.<br>- Initiate research on technologies needed to enable multi-INT sensors to collaborate in real time on complex fusion tasks.<br>- Initiate research in the detection of partially observed patterns of interest in large and diverse data streams.<br>- Initiate research in representing the content of large data stores in a way that allows remote and accurate searching against data indexes to be enabled.<br>- Initiate research in deep machine understanding of information requirements relevant to amphibious warfare.<br>- Initiate research in characterizing patterns of life from persistent track data.<br>- Initiate research on collapsing networks inferred from disparate data sources. | | | |
| ***Title:*** LITTORAL COMBAT/POWER PROJECTION | 10.000 | 10.200 | 10.404 |
| ***Description:*** This activity addresses the applied research associated with the Marine Corps participation in the Department of the Navy's (DoN) Science and Technology Future Naval Capabilities (FNC) Program. The FNC Program represents the requirements-driven, delivery-oriented portion of the DoN Science and Technology (S&T) portfolio. FNC investments respond to Naval S&T Gaps that are generated by the Navy and Marine Corps after receiving input from Naval Research Enterprise (NRE) stakeholders. The funding is aligned with the Naval challenges associated with projecting power despite anti-access and area denial, specifically the Sea Shield, Power and Energy, FORCEnet, and the Naval Expeditionary Maneuver Warfare warfighting capability gaps. The funding profile reflects the alignment of the FNC program investments into Enabling Capabilities (ECs); ECs respond to priority Naval warfighting capability gaps. Funding for each EC is aligned to a 6.2 or 6.3 Budget Activity (BA) as | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

appropriate. Concurrent funding for Naval Expeditionary Warfare capability ECs is also provided from Navy PE0602750N and PE0603673N. Both of the Navy PE's were included in the FY 2013 President's Budget Request and are now the only program elements funding Navy FNC work. In previous submissions 7 Navy 6.2 PEs and 8 Navy 6.3 PEs funded FNC efforts.

***FY 2013 Accomplishments:***

- Continued development and began transitioning EFV obstacle detection capability to EFV Direct Reporting Program Manager.
- Continued development of Modular Scalable Effects weapons technologies. (Concurrent funding in PE 0603640M).
- Continued development of tactical urban breaching technologies. Due to required program necessities resourcing of continued development of tactical urban breaching technologies has been realigned to PE 0603640M.
- Continued development of technologies to lighten-the-load of warfighters by: 1) reducing the weight and improving the capability of the day/night weapon sight; 2) eliminating battery incompatability; and 3) providing Graphical User Interface (GUI)-based software for tradeoff analyses based on Military Operational Posture. (Concurrent funding provided by PE 0603064M and PR 0603236N).
- Continued development of wide area surgical and persistent survellience technologies. (Concurrent funding provided by PE 0602271N and PE 0603640M).
- Completed development and began transitioning Expeditionary Fighting Vehicle (EFV) obstacle detection capability to EFV Direct Reporting Program Manager (EFV POR terminated).
- Completed development of integrated vehicle self-defense system to defeat incoming RPGs.
- Completed transparent urban structure 'see thru the wall', image and mapping technologies development.
- Completed development of an integrated, company level, Urban Sensor Suite. (Automated Control of Large Sensor Networks).
- Completed detect and identify facilities technology development. (Transparent Urban Structures).
- Completed decision aids technology development. (Transparent Urban Structures).
- Completed indirect prototype technology development. (Modular Scalable Effects Weapon).
- Completed development of Modular Scalable Effects weapons technologies.
- Completed development of counter Improvised Explosive Device (IED) technologies.
- Completed development of tactical urban breaching technologies.
- Completed development of individual Warfighter protection technologies.
- Completed development of advanced survivability and mobility technologies for Marine Corps tactical and combat vehicles.
- Initiated development of precision universal mortar attack technologies. (Concurrent funding in PE 060640M).

***FY 2014 Plans:***

- Continue all efforts from FY 2013, except those noted as completed.
- Continue development and began transitioning EFV obstacle detection capability to EFV Direct Reporting Program Manager.
- Continue development of Modular Scalable Effects weapons technologies. (Concurrent funding in PE 0603640M).

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue development of tactical urban breaching technologies. Due to required program necessities resourcing of continued development of tactical urban breaching technologies has been realigned to PE 0603640M.<br>- Continue development of wide area surgical and persistent surveillence technologies. (Concurrent funding provided by PE 0602271N and PE 0603640M).<br>- Continue Initiated development of precision universal mortar attack technologies. (Concurrent funding in PE 060640M).<br>- Complete development of technologies to lighten-the-load of warfighters by: 1) reducing the weight and improving the capability of the day/night weapon sight; 2) eliminating battery incompatibility; and 3) providing Graphical User Interface (GUI)-based software for tradeoff analyses based on Military Operational Posture.<br>- Complete development of precision universal mortar attack technologies. (Concurrent funding in PE 0603640M). | | | |
| ***FY 2015 Plans:***<br>- Continue development of wide area surgical and persistent surveillence technologies. (Concurrent funding provided PE 0603640M.)<br>- Continue development of the Ground Based Air Defense On-the-move high energy laser demonstrator. (Concurrent funding in PE 0603640M).<br>- Continue development and began transitioning EFV obstacle detection capability to EFV Direct Reporting Program Manager.<br>- Complete development of integrated vehicle self-defense system to defeat incoming RPGs.<br>- Complete transparent urban structure 'see thru the wall', image and mapping technologies development.<br>- Complete development of an integrated, company level, Urban Sensor Suite. (Automated Control of Large Sensor Networks Transitions to PE 0602235N).<br>- Complete detect and identify facilities technology development. (Transparent Urban Structures).<br>- Complete decision aids technology development.<br>- Complete development of Modular Scalable Effects weapons technologies. (Concurrent funding in PE 0603640M).<br>- Complete development of tactical urban breaching technologies. Due to required program necessities resourcing of continued development of tactical urban breaching technologies has been realigned to PE 0603640M.<br>- Complete development of individual Warfighter protection technologies. (Concurrent funding in PE 0603640M).<br>- Complete development of advanced survivability and mobility technologies for Marine Corps tactical and combat vehicles. (Concurrent funding in PE 0603640M and 0603236N).<br>- Initiate development of an azimuth and inertial navigation system. (Effort was previously funded by PE 0602750N and PE 0603673N; concurrent funding in PE 0603640M.)<br>- Initiate and complete development of spectral and reconnaissance imagery for tactical exploitation (SPRITE). (Previous and follow-on funding provided by PE 0602750N and PE 0603673N; concurrent funding in PE 0602131M.)<br>- Initiate limited development of Target Processing Center (TPC) sensor correlation and fusion technology; specifically, context fusion, and radar fusion and false track mitigation. (Concurrent funding in PE 0603640M.) | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate development of technologies to enable the exchange of actionable information at the tactical edge; specifically, actionable information tactical applications, data conditioning and network adaptive communication services. (Effort was previously funded by PE 0602750N and PE 0603673N; concurrent funding in PE 0603640M.) | | | |
| ***Title:*** LOGISTICS | 4.780 | 5.615 | 4.534 |
| ***Description:*** 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.<br><br>The FY 2014 to FY 2015 funding decrease is due to the early completion and transition of a solid oxide fuel cell capable of directly oxidizing liquid logistic fuels.<br><br>***FY 2013 Accomplishments:***<br>- Continued advancement of high specific energy electrochemical capacitors to function as peak electric load-leveling buffers in advanced, lightweight, portable power applications.<br>- Continued applications of advanced material surface treatments and coatings for reducing required maintenance and enhancing operational readiness of expeditionary warfare vehicles, machinery, and electrical systems (Note: This also includes development of alternative human load carrying concepts to lighten the load carried by the Marine and reduce structural damage to the human body).<br>- Continued 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.<br>- Continued applied research toward producing a light weight device for converting hydrocarbon fuels to electrical energy.<br>- Continued applied research toward an extremely high specific energy, metal-air primary battery and research toward an advanced electrochemical ultracapacitor based on down-selection of prior research approaches.<br>- Continued development of water purification applied research focused toward small personal water purification devices. This includes previous work in an energy recovery system for enhancing the efficiency of small reverse osmosis water purification devices.<br>- Continued applied research into electrochemical methods of converting diverse hydrocarbon fuels to electrical energy.<br>- Continued applied research toward materials that will reduce, or prevent, wear and corrosion on systems and equipment.<br>- Completed the development of a backpack that generates electric power from human motion. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| This effort was initiated in FY 2009 (harnessing walking power).<br><br>***FY 2014 Plans:***<br>- Continue all efforts from FY 2013, except those noted as completed.<br>- Continue advancement of high specific energy electrochemical capacitors to function as peak electric load-leveling buffers in advanced, lightweight, portable power applications.<br>- Continue applications of advanced material surface treatments and coatings for reducing required maintenance and enhancing operational readiness of expeditionary warfare vehicles, machinery, and electrical systems (Note: This also includes development of alternative human load carrying concepts to lighten the load carried by the Marine and reduce structural damage to the human body).<br>- Continue 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.<br>- Continue applied research toward producing a light weight device for converting hydrocarbon fuels to electrical energy.<br>- Continue applied research toward an extremely high specific energy, metal-air primary battery and research toward an advanced electrochemical ultracapacitor based on down-selection of prior research approaches.<br>- Continue development of water purification applied research focused toward small personal water purification devices. This includes previous work in an energy recovery system for enhancing the efficiency of small reverse osmosis water purification devices.<br>- Continue applied research into electrochemical methods of converting diverse hydrocarbon fuels to electrical energy.<br>- Continue applied research toward materials that will reduce, or prevent, wear and corrosion on systems and equipment.<br>- Complete development of self lubricating coatings that will reduce maintenance expense and down time of systems and equipment.<br>- Complete research on hydrodynamic particle separation technologies for enhancing the life of water purification technologies at the small scale.<br>- Complete research on photocatalytic technologies for un-powered water purification at the small scale.<br>- Complete development of adsorbed membrane coatings to provide enhanced fouling resistance in membrane-based water purification systems.<br>- Initiate the development of logistics IT systems for optimizing the transportation of materiel across multiple intra and inter-theater connector vehicles (aka, TET).<br>- Initiate development of high efficiency, rugged, and inexpensive solar photovoltaic energy harvesting technologies (aka, Solar Blanket).<br>- Initiate development technologies to facilitate cargo transfer across intra-theater logistics connector vehicles, to include advanced material handling equipment as well as asset tracking and reporting technologies. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate the development of advanced water location, harvesting, packaging, distribution, and quality monitoring systems to enable Marines to be fully self-sufficient for water resources on the battlefield.<br><br>***FY 2015 Plans:***<br>- Complete advancement of high specific energy electrochemical capacitors to function as peak electric load-leveling buffers in advanced, lightweight, portable power applications.<br>- Complete 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.<br>- Complete applied research toward producing a light weight device for converting hydrocarbon fuels to electrical energy.<br>- Complete applied research toward an extremely high specific energy, metal-air primary battery and research toward an advanced electrochemical ultracapacitor based on down-selection of prior research approaches.<br>- Complete applied research into electrochemical methods of converting diverse hydrocarbon fuels to electrical energy.<br>- Continue development of water purification applied research focused toward small personal water purification devices. This includes previous work in an energy recovery system for enhancing the efficiency of small reverse osmosis water purification devices.<br>- Continue applications of advanced material surface treatments and coatings for reducing required maintenance and enhancing operational readiness of expeditionary warfare vehicles, machinery, and electrical systems (Note: This also includes development of alternative human load carrying concepts to lighten the load carried by the Marine and reduce structural damage to the human body).<br>- Continue applied research toward materials that will reduce, or prevent, wear and corrosion on systems and equipment.<br>- Continue the development of logistics IT systems for optimizing the transportation of materiel across multiple intra and inter-theater connector vehicles (aka: Transportation Exploitation Tool).<br>- Continue development of high efficiency, rugged, and inexpensive solar photovoltaic energy harvesting technologies.<br>- Continue development technologies to facilitate cargo transfer across intra-theater logistics connector vehicles, to include advanced material handling equipment as well as asset tracking and reporting technologies.<br>- Continue the development of advanced water location, harvesting, packaging, distribution, and quality monitoring systems to enable Marines to be fully self-sufficient for water resources on the battlefield.<br>- Initiate operations research and analysis efforts to enhance seabased expeditionary supply chain concepts and technologies.<br>- Initiate development of infrastructureless In-Transit Visibility (ITV) technologies to enable asset tagging, tracking, locating, and monitoring anywhere in the expeditionary supply chain.<br>- Initiate the development of modular thermoacoustic systems capable of acting as power generation or heat-pump devices.<br>- Initiate the development of energy scavenging technologies to minimize wasted thermal, RF, kinetic, and other energy on the battlefield. | | | |
| ***Title:*** MANEUVER | 6.843 | 8.038 | 6.985 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

***Description:*** 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 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.

The FY 2014 to FY 2015 decrease in funding is due to a decrease in the plans to initiate and develop autonomous technologies transcribing vision-based perception data.

***FY 2013 Accomplishments:***
- Continued lightweight Expeditionary Systems Materials (ESM) efforts to determine feasibility of scaling and producing candidate structural armor.
- Continued development of Advanced Electro-Magnetic Armor (AEMA) for ground vehicle survivability.
- 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 efforts addressing survivability and technologies to mitigate acceleration and traumatic brain injuries to vehicle occupants to enhance tactical mobility.
- Continued 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.
- Continued efforts addressing improvements in vehicle fuel efficiency by improvements in drive train efficiencies, engine efficiencies and alternative fuels capabilities to enhance tactical mobility.
- Continued 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.
- Continued 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.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued efforts in advanced perception and context-based reasoning aimed at the development of an autonomous vehicle capability that will provide mobility and logistics support to the dismounted Marine during Enhanced Company Operations (ECO).<br>- Continued Survivability efforts in Advanced Blast Mitigation to develop solutions that mitigate injuries to vehicle occupants, while reducing the weight burden, thereby enhancing tactical mobility and survivability. These efforts were delayed from FY 2011 due to a shift in program priorities which necessitated allocating the funds to the development of autonomous vehicle capabilities.<br>- Continued Advanced Mobility efforts in Future Fuel Alternatives and Advanced Propulsion and Suspension Technologies to improve vehicle fuel efficiency through improvements in drive train and engine efficiencies and alternative fuels capabilities to enhance tactical mobility. | | | |
| ***FY 2014 Plans:***<br>- Continue all efforts from FY 2013, except those noted as completed.<br>- Continue lightweight Expeditionary Systems Materials (ESM) efforts to determine feasibility of scaling and producing candidate structural armor.<br>- Continue development of Advanced Electro-Magnetic Armor (AEMA) for ground vehicle survivability.<br>- Continue mobility enhancement development effort for current and future light and medium weight Marine Corps vehicle programs.<br>- Continue and completed development of materials to promote Combat Science and Technology Vehicle (CSTV) survivability.<br>- Continue efforts addressing survivability and technologies to mitigate acceleration and traumatic brain injuries to vehicle occupants to enhance tactical mobility.<br>- Continue 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.<br>- Continue efforts addressing improvements in vehicle fuel efficiency by improvements in drive train efficiencies, engine efficiencies and alternative fuels capabilities to enhance tactical mobility.<br>- Continue 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.<br>- Continue 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.<br>- Continue efforts in advanced perception and context-based reasoning aimed at the development of an autonomous vehicle capability that will provide mobility and logistics support to the dismounted Marine during Enhanced Company Operations (ECO).<br>- Continue Survivability efforts in Advanced Blast Mitigation to develop solutions that mitigate injuries to vehicle occupants, while reducing the weight burden, thereby enhancing tactical mobility and survivability. These efforts were delayed from FY 2011 due to a shift in program priorities which necessitated allocating the funds to the development of autonomous vehicle capabilities. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Advanced Mobility efforts in Future Fuel Alternatives and Advanced Propulsion and Suspension Technologies to improve vehicle fuel efficiency through improvements in drive train and engine efficiencies and alternative fuels capabilities to enhance tactical mobility.<br>- Initiate the development of autonomy technologies and system concepts that will enable unmanned ground vehicles (UGVs) to be used as autonomous logistic connector vehicles.<br>- Initiate the development of fuel saving vehicle technologies, including advanced transmission, power train, and electrical power system technologies.<br>- Initiate mobility technologies that enable improved vehicle agility and stability.<br>- Initiate lightweight armor, material, and structural technologies that enable maneuver and survivability of small, light expeditionary platforms.<br>- Initiate survivability technologies that enable defeat of all unitary and tandem RPG and select ATGM threats, and the demonstration of survivable vehicles.<br>- Initiate non-GPS localization technologies such that autonomous vehicles can navigate in areas where satellite data is inaccessible.<br>- Initiate the development of technologies that enable vehicle component modularity and reduce life cycle costs. | | | |
| ***FY 2015 Plans:***<br>- Continue lightweight Expeditionary Systems Materials (ESM) efforts to determine feasibility of scaling and producing candidate structural armor.<br>- Continue mobility enhancement development effort for current and future light and medium weight Marine Corps vehicle programs.<br>- Continue efforts addressing survivability and technologies to mitigate acceleration and traumatic brain injuries to vehicle occupants to enhance tactical mobility.<br>- Continue 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.<br>- Continue efforts addressing improvements in vehicle fuel efficiency by improvements in drive train efficiencies, engine efficiencies and alternative fuels capabilities to enhance tactical mobility.<br>- Continue 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.<br>- Continue 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.<br>- Continue efforts in advanced perception and context-based reasoning aimed at the development of an autonomous vehicle capability that will provide mobility and logistics support to the dismounted Marine during Enhanced Company Operations (ECO). | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue the development of autonomy technologies and system concepts that will enable unmanned ground vehicles (UGVs) to be used as autonomous logistic connector vehicles.<br>- Continue lightweight armor, material, and structural technologies that enable maneuver and survivability of small, light expeditionary platforms.<br>- Continue survivability technologies that enable defeat of all unitary and tandem RPG and select ATGM threats, and the demonstration of survivable vehicles.<br>- Continue non-GPS localization technologies such that autonomous vehicles can navigate in areas where satellite data is inaccessible.<br>- Continue the development of technologies that enable vehicle component modularity and reduce life cycle costs.<br>- Continue mobility technologies that enable improved vehicle agility and stability.<br>- Continue Advanced Mobility efforts in Future Fuel Alternatives and Advanced Propulsion and Suspension Technologies to improve vehicle fuel efficiency through improvements in drive train and engine efficiencies and alternative fuels capabilities to enhance tactical mobility.<br>- Continue development of Advanced Electro-Magnetic Armor (AEMA) for ground vehicle survivability.<br>- Complete survivability efforts in advanced blast mitigation to develop solutions that mitigate injuries to vehicle occupants, while reducing the weight burden, thereby enhancing tactical mobility and survivability.<br>- Initiate the development of fuel saving vehicle technologies, including advanced transmission, power train, and electrical power system technologies.<br>- Initiate the development of autonomous technologies transcribing vision-based perception data in order to be understood by a context-based reasoning system enabling adaptive behavior.<br>- Initiate the development of autonomous technologies by enhanced human machine interface (HMI) through gestures and natural language understood by unmanned ground systems (UGS).<br>- Initiate survivability technologies to provide reduction in the probability of detection in a given background. | | | |
| ***Title:*** COMMAND, CONTROL, COMMUNICATIONS, AND COMPUTERS (C4) | 3.579 | 4.183 | 4.256 |
| ***Description:*** This activity supports S&T investment in Command and Control and is focused in three main areas: (1) Implementing the FORCEnet concept; (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; and (3) Providing effective combat identification of enemy combatants, friendly forces, and non-combatants. 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 from 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. Activities in this program area provide technologies for secure, robust, self-forming, mobile communications networks and | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

distributed computing to support information dissemination to all echelons; and sensors, software and data processing to support formation of an appropriate common picture. Marine Corps specific efforts include power management, low detectability, size and weight constraints, and interoperability within the joint environment.

***FY 2013 Accomplishments:***
- Continued development of urban/restricted environment communications technologies.
- Continued 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.
- Continued Adaptable Antennas, Self-Adapting Radio Prototype and RF Technologies efforts.
- Continued Cognitive Networking Technologies, Mobile Security Architecture Technologies, and Small Unit Blue Force tracking/ Position Location Information/Combat Identification Technologies efforts.
- Continued Cognitive Networking and Trusted Computing Technology efforts. These technologies were planned for initiation in FY 2011 but were delayed until FY 2012 due to unforeseen technical delays.
- Completed Mobile Security Architecture, Small Unit Decision Aids, Position Location and Self-Adapting Radio Prototype efforts. These Small Unit C4 Technologies were initiated in FY 2009.
- Initiated Dynamic Cosite Mitigation, Sensing Comms and Blue Force Tracking efforts.

***FY 2014 Plans:***
- Continue all efforts from FY 2013, except those noted as completed.
- Continue development of urban/restricted environment communications technologies.
- Continue 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.
- Continue Adaptable Antennas, Self-Adapting Radio Prototype and RF Technologies efforts.
- Continue Cognitive Networking Technologies, Mobile Security Architecture Technologies, and Small Unit Blue Force tracking/ Position Location Information/Combat Identification Technologies efforts.
- Continue Cognitive Networking and Trusted Computing Technology efforts. These technologies were planned for initiation in FY 2011 but were delayed until FY 2012 due to unforeseen technical delays.
- Continue Dynamic Cosite Mitigation, Sensing Comms and Blue Force Tracking efforts.
- Complete Small Unit Blue Force tracking/Position Location Information/Combat Identification Technologies effort.
- Complete Self-Adapting Radio Prototype efforts.
- Initiate a meta-material antennas effort.
- Initiate a distributed, Cyber Technology development effort.

***FY 2015 Plans:***
- Continue development of urban/restricted environment communications technologies.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602131M / *Marine Corps Lndg Force Tech* | **Project (Number/Name)**<br>3001 / *Marine Corps Landing Force Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Adaptable Antennas, Self-Adapting Radio Prototype and RF Technologies efforts.<br>- Continue Cognitive Networking and Trusted Computing Technology efforts. These technologies were planned for initiation in FY 2011 but were delayed until FY 2012 due to unforeseen technical delays.<br>- Continue a distributed, Cyber Technology development effort.<br>- Complete Dynamic Cosite Mitigation, Sensing Comms and Blue Force Tracking efforts.<br>- Complete 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.<br>- Initiate a meta-material antennas effort. (This activity was planned for FY 2014, but due to fiscal constraints it was not initiated until FY 2015.")<br>- Initiate an Electro-Magnetic Technologies effort. | | | |
| **Accomplishments/Planned Programs Subtotals** | 41.687 | 47.334 | 45.831 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**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, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | | | | | R-1 Program Element (Number/Name)<br>PE 0602235N *I Common Picture Applied Research* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 37.643 | 34.136 | 43.541 | - | 43.541 | 42.681 | 42.821 | 37.482 | 37.578 | Continuing | Continuing |
| 0000: *Common Picture Applied Research* | 0.000 | 37.643 | 34.136 | 43.541 | - | 43.541 | 42.681 | 42.821 | 37.482 | 37.578 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

FY 2013 funding and associated Future Naval Capability (FNC) efforts addressed in this Program Element (PE) are transferring to a new PE titled Future Naval Capabilities Applied Research (PE 0602750N). This is to enhance the visibility of the FNC Program by providing an easily navigable and consolidated overview of all 6.2 FNC investments in a single PE.

FY 2014 - R2 Activity Human Factors and Organizational Design requirements and associated funding is transferred to the Warfighter Sustainment Applied research PE (PE 0602236N). Ongoing Human Factors research is more closely aligned to Warfighter Sustainment objectives.

**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 (Sep 2011). 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 investments in the following Enabling Capabilities (ECs): Combat Identification (ID) Information Management of Coordinated Electronic Surveillance; Automated Control of Large Sensor Networks; OCO 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; Pro-Active Computer Network Defense and Information Assurance; Fast Magic; Naval Research Laboratory (NRL) Space; Advanced Tactical Data Link; and Autonomous Tactical Persistent Surveillance. 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).

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | **R-1 Program Element (Number/Name)**<br>PE 0602235N *I Common Picture Applied Research* |

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

| B. Program Change Summary ($ in Millions) | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 41.696 | 34.163 | 35.528 | - | 35.528 |
| Current President's Budget | 37.643 | 34.136 | 43.541 | - | 43.541 |
| Total Adjustments | -4.053 | -0.027 | 8.013 | - | 8.013 |
| • Congressional General Reductions | - | -0.027 | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | - | - | | | |
| • SBIR/STTR Transfer | -0.573 | - | | | |
| • Program Adjustments | - | - | 2.013 | - | 2.013 |
| • Rate/Misc Adjustments | - | - | 6.000 | - | 6.000 |
| • Congressional General Reductions Adjustments | -3.480 | - | - | - | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 2 | R-1 Program Element (Number/Name)<br>PE 0602235N / *Common Picture Applied Research* | Project (Number/Name)<br>0000 / *Common Picture Applied Research* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000: *Common Picture Applied Research* | - | 37.643 | 34.136 | 43.541 | - | 43.541 | 42.681 | 42.821 | 37.482 | 37.578 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 (Sep 2011). 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 investments in the following Enabling Capabilities (ECs): Combat Identification (ID) Information Management of Coordinated Electronic Surveillance; Automated Control of Large Sensor Networks; OCO 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; Pro-Active Computer Network Defense and Information Assurance; Fast Magic; Naval Research Laboratory (NRL) Space; Advanced Tactical Data Link; and Autonomous Tactical Persistent Surveillance. 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).

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** COMMUNICATION AND NETWORKS | 6.617 | 7.471 | 7.151 |
| ***Description:*** The overarching objective of this activity is to develop high throughput dynamic wireless communications and network 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, | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| including coalition and allied forces. Emphasis is on tactical edge communications and networks to fully realize net-centric warfare, bridging the Global Information Grid (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:<br><br>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, antijam 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 sensor 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.<br><br>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.<br><br>The decrease from FY 2014 to FY 2015 is the reprioritizing of the Development of optical communications technologies for underwater platforms and research into multi-modal networking across undersea platforms with acoustic, optical, and RF communications. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.<br><br>***FY 2013 Accomplishments:***<br>Radios and Apertures:<br>- Continued development of low intercept and low probability of Detection (LPD), jam resistant communications/networks for distributed nodes.<br>- Continued blue-green fiber laser technology development for space-based submarine communications.<br>- Continued design and development of low observable, jam resistant waveform, including directionalization, for advanced tactical data links.<br>- Continued design and development of electronic protection for HF communications.<br>- Continued development of structurally integrated HF antennas.<br>- Continued development of integrated metamaterial antennas for ship and ground platforms.<br>- Continued demonstration of high peak power, short pulse operation of fiber lasers in blue-green region.<br>- Continued development of optical wavefront modulation techniques and optical phased array beam steering methods for terrestrial EO/IR Lasercomm.<br>- Continued development of new architecture and modes of operation for advanced tactical data link operation in both contested and anti-access regions.<br>- Continued novel fiber technology that enables tunable, energy-scalable emissions at a user-defined/desired wavelength, particularly in the blue-green spectral range.<br>- Continued use of novel metamaterials and metastructures that enable conformal antenna designs with ultra-wideband performance.<br>- Continued program for a novel blade antenna payload for wideband Ku/UHF communications that is light weight, has lower power consumption, and is very low cost.<br>- Complete development and demonstrate electrically small antennas at Very Low Frequency/High Frequency (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.<br>- Initiated technologies to improve spectrum co-existence of military waveforms with commercial communications (e.g., overlay/ underlay techniques, interference cancellation, machine learning and reasoning algorithms for distributed spectral awareness/ management, etc.).<br><br>Tactical Networking and Network Control/Management:<br>- Continued development of topology control, discovery mechanisms and directional networking for free space optical links.<br>- Continued design and development of cognitive netops for tactical communications.<br>- Continued development of social network analysis algorithms for protecting wireless networks. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of cognitive networking, cross-layer optimization protocols for light SOA for tactical networks.<br>- Continued development of effort to improve secure voice by developing secure voice technology that can interoperate between tactical and strategic networks.<br>- Continued program that leverages topology discovery, content modeling, and resource scheduling to support content management functions at the Tactical Edge.<br>- Continued managing and controlling functions within a protected routing core at the Tactical Edge.<br>- Continued an investigation of applied wireless communication network science for autonomous, mobile information networks.<br>- Completed effort to improve secure voice by developing secure voice technology that can interoperate between tactical and strategic networks.<br>- Completed development of agent based communications, control and distributed authentication techniques in dynamic MANET networks.<br>- Completed 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.<br>- Initiated dynamic routing mechanisms that focus on robust data delivery -- in near real time -- under harsh networking conditions (i.e., intermittent connectivity, limited throughput, etc.). | | | |
| ***FY 2014 Plans:***<br>Radios and Apertures:<br>- Continue all efforts of FY 2013 less those noted as complete.<br>- Complete design and development of low observable, jam resistant waveform, including directionalization, for advanced tactical data links.<br>- Complete structurally integrated HF antennas.<br>- Complete new architecture and modes of operation for advanced tactical data link operation in both contested and anti-access regions.<br>- Initiate development of low cost approaches for electronic beam steering and multi-beam RF systems<br>- Initiate development of blue-green receiver and detector technologies with greater sensitivity, while reducing size, weight, power, and/or cost.<br><br>Tactical Networking and Network Control/Management:<br>- Continue all efforts of FY 2013 less those noted as complete.<br>- Complete development of topology control, discovery mechanisms and directional networking for free space optical links.<br>- Complete social network analysis algorithms for protecting wireless networks.<br>- Complete an investigation of applied wireless communication network science for autonomous, mobile information networks. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate development of techniques and algorithms to manage resources of tactical networks in a manner consistent with Commander's Intent.<br><br>***FY 2015 Plans:***<br>Radios and Apertures:<br>- Continue all efforts of FY 2014 less those noted as complete.<br>- Complete blue-green fiber laser technology development for space-based submarine communications.<br>- Complete novel fiber technology that enables tunable, energy-scalable emissions at a user-defined/desired wavelength, particularly in the blue-green spectral range.<br>- Complete development of low intercept and low probability of Detection (LPD), jam resistant communications/networks for distributed nodes.<br>- Complete development of optical wavefront modulation techniques and optical phased array beam steering methods for terrestrial EO/IR Lasercomm.<br>- Complete use of novel metamaterials and metastructures that enable conformal antenna designs with ultra-wideband performance.<br>- Complete program for a novel blade antenna payload for wideband Ku/UHF communications that is light weight, has lower power consumption, and is very low cost.<br>- Initiate development of technologies to enable troposcatter communications on the move with reduced size, weight, and power antennas.<br>- Initiate development of blue-green filter technologies with wide field of view, narrow bandwidth, and reduced size, weight, complexity, etc.<br><br>Tactical Networking and Network Control/Management:<br>- Continue all efforts of FY2014 less those noted as complete.<br>- Complete development of cognitive networking, cross-layer optimization protocols for light SOA for tactical networks.<br>- Complete development of effort to improve secure voice by developing secure voice technology that can interoperate between tactical and strategic networks.<br>- Complete program that leverages topology discovery, content modeling, and resource scheduling to support content management functions at the Tactical Edge.<br>- Complete managing and controlling functions within a protected routing core at the Tactical Edge.<br>- Initiate development of techniques and algorithms to ensure end-to-end delivery of data across undersea networks with large delays and multi-modal communications. | | | |
| ***Title:*** APPLIED INFORMATION SCIENCES FOR DECISION MAKING | 9.777 | 15.618 | 23.211 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Description:*** 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 Nano Electronics Technology activity is focused on developing ultra-low power, higher performance computing devices and components that are based on novel functionalities of nanometer scale materials and are enabled by improved understanding of nanomaterials, new devices and circuit design concepts, as well as new architectures uniquely suited for nanoscale systems.<br><br>Effective in FY 2013, this activity title has been changed from Computational Framework and Methods for Rapid Accurate Decision Making to Applied Information Sciences for Decision Making in order to completely capture the work being performed.<br><br>The current specific objectives are:<br>a) Data Understanding (Formerly: 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 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.<br><br>b) Information Integration (Formerly; 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, while inferring relationships and their intentions.<br><br>c) Mission Focused Autonomy (MFA): Develop proactive situational awareness and rapid decision making applications and analytics with information PUSH as well as PULL, where joint human controlled and automated analytic processes can collaboratively work together to solve tactical and strategic problems within a multi-level, secure environment. The MFA system contains the following elements: a) access to enterprise level structured and unstructured data repositories and automated search and discovery of evidence collected across these heterogeneous databases; b) analytics that automate the ability to infer the meaning of evidence that is discovered; c) structured process (hypothesis or argument) that provides context in order to | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| constrain and guide the search and analytic techniques toward goals that are focused on proving the hypothesis right or wrong; d) knowledge repository that maintains pedigree and state of hypothesis satisfaction or refutation; e) Collaborative environment wherein all analytic participants can share the state of hypothesis satisfaction and collectively contribute evidence data to solve the common problem. Develop rigorous and efficient methods for building sophisticated situational models, and develop automated reasoning techniques to categorize and recognize situations under a variety of conditions leading to methods that predict situations under different settings.<br><br>d) Resource Optimization (Formerly: 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, achieving 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.<br><br>e) Trusted Systems & Networks (Formerly: Secure Sensor Networks): Develop tools and methods to securely handle information without exposing intelligence information about the networks or systems to adversaries.<br><br>f) Nanoscale Electronics: To develop novel nanometer scale (feature size near 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. Effective in FY 2014, Nanoscale Electronics has been transferred from Electromagnetic Systems Applied Research to Applied Information Sciences for Decision Making in order to completely capture the work being performed.<br><br>g) Quantum Information Sciences: Conduct research supporting the efficacy of a free space optical quantum key distribution that would operate in a maritime environment. Understand the implications of imperfect hardware implementations upon the vulnerability of the known protocols. Develop new protocols and encoding schemes that lead to robust performance with high throughput. Conduct research that leads to an understanding of, and develop methods that compensate for atmospheric effects.<br><br>The increase from FY 2013 to FY 2014 is a result of the expanded investment in Mission Focused Autonomy research and the transfer of requirements and associated funding for Nanoscale Electronics Research from PE 0602271N.<br><br>The increase of funds from FY2014 to FY2015 is for the development and demonstration of new naval capabilities providing improved cyber situational awareness and cyber toolkit development to assess vulnerabilities in Naval networks. The funds will also explore new technologies to prevent/ isolate intrusions to Naval networks and explore automated approaches to cyber policy implementation management. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

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

***FY 2013 Accomplishments:***

Data Understanding:

- Continued development of methods for integration of low-level image processing and high-level knowledge for simultaneous image segmentation and object recognition, and visual reasoning for image understanding.
- Continued development of 3D image processing for object recognition and meaningful change detection.
- Continued development of modular, interactive, intelligent, video-based surveillance systems.
- Continued development of a vision-based system for tactical unmanned aerial vehicle to navigate paths without requiring maps or GPS.
- Continued methods for building sophisticated visual knowledge bases, development of methods for visual reasoning and integrating them in image/video understanding, and development of methods for image description.
- Completed development and demonstration of revolutionary, hyperspectral imaging spectrometer algorithms and system.

Information Integration:

- Continued development of algorithms and tools for information representation of unstructured data and structured data in such a way that shared concepts/relationships in disparate data sets can be automatically compared, matched, or associated, and in a way that can facilitate and improve information fusion.
- Continued development of algorithms and tools for information fusion of heterogeneous data for classification and reconstruction based on high level features inherent in each data source, with the goal of forming a more complete picture of battlespace environment.
- Continued development of algorithms and tools for discovering and extracting higher-level features -- objects, events, patterns, intents, relationships, anomalies -- from various data types in support of future asymmetric warfare.

Mission Focused Autonomy (MFA):

- Continued research in mission-focused autonomy and reasoning methods; expanded autonomy from simple platform kinematics to include all-source information exploitation and surrounding cultural and social influences.

Resource Optimization:

- Continued 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, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of optimization-based decision aids for resource allocation, such as those required for mission planning at the strategic, operational, and tactical level.<br><br>Trusted Systems & Networks:<br>- Continued development of anti-tamper methods that are capable of lengthy operation in unattended and un-powered environments, have very high probability of tamper detection and very low probability of false alarm, and remain undetected in the host system.<br>- Continued development of automated tools that identify and mitigate potential software vulnerabilities, such as tools that analyze code as it is being written, vulnerability-aware compilers that automatically enhance code security, and techniques for enhancing the client-side security of web applications.<br>- Continued development of theory, methods, and tools for model-driven, component-based construction and automatic verification of software systems. | | | |
| ***FY 2014 Plans:***<br>Data Understanding:<br>- Continue all efforts from FY 2013 less those noted as completed above.<br>- Complete effort to develop a vision-based system for tactical unmanned aerial vehicle to navigate paths without requiring maps or GPS. (NRL)<br>- Initiate development of algorithms for extraction of information from Light Detection and Ranging (LIDAR) and Radar.<br><br>Information Integration:<br>- Continue all efforts from FY 2013 less those noted as completed above.<br>- Initiate development of methods for analysis and integration of text with imagery and video.<br>- Initiate development of methods for analysis of structured and unstructured data.<br><br>Mission Focused Autonomy (MFA):<br>- Continue all efforts from FY 2013 less those noted as completed above.<br>- Bring capability into a multi-level security environment<br>- Automate current set of time critical reports to ensure timely decision making that is informed by forensics data<br><br>Resource Optimization:<br>- Continue all efforts from FY 2013 less those noted as completed above.<br><br>Trusted Systems & Networks: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts from FY 2013 less those noted as completed above.<br><br>Nanoscale Electronics: (Beginning in FY 2014, efforts listed below are continued from PE 0602271)<br>- Continue effort to develop a highly linear, low-noise RF amplifier using aligned arrays of single-walled carbon nanotubes.<br>- Continue new research in graphene synthesis and device concepts.<br>- Continue effort to develop the synthesis, fabrication and testing of graphene-based electromechanical structures and devices.<br>- Continue work on graphene-based devices and circuits for low power flexible electronics.<br>- Continue research on graphene-organic hybrid materials interfaces and device structures.<br>***FY 2015 Plans:***<br>Data Understanding:<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Complete development of electronic protection techniques for long range emitter classification systems.<br><br>Information Integration:<br>- Continue all efforts of FY 2014, less those noted as completed above.<br><br>Mission Focused Autonomy (MFA):<br>- Continue FY14 efforts expanding the use cases<br>- Initiate integrating this analytic environment into parallel Navy Tactical Cloud environment<br><br>Resource Optimization:<br>- Continue all efforts from FY 2014 less those noted as completed above.<br><br>Trusted Systems & Networks:<br>- Continue all efforts from FY 2014 less those noted as completed above.<br>- Complete development of theory, methods, and tools for model-driven, component-based construction and automatic verification of software systems.<br><br>Nanoscale Electronics: (Beginning in FY 2014, efforts listed below are continued from PE 0602271)<br>- Continue all efforts of FY 2014, less those noted as completed above.<br><br>Quantum Information Sciences: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate free-space Quantum Key Distribution applied research program for secure communication. | | | |
| ***Title:*** HUMAN FACTORS AND ORGANIZATIONAL DESIGN | 5.701 | - | - |
| ***Description:*** 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 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:<br><br>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.<br><br>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 scenarios. 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.<br><br>c) Organizational Design and Decision Support Systems: Develop quantitative, executable models, task graphs and optimization algorithms for the organizational design of MOC, consistent with the Navy's New Maritime Strategy. Investigate through modeling | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| 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).<br><br>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.<br><br>The decrease from FY 2013 to FY 2014 is due to the transfer of requirements and associated funding to the Human Factors activities in the Warfighter Sustainment Applied Research PE 0602236N, to provide an easily navigable and consolidated overview of all Human Factors investments in a single PE.<br><br>The following are non-inclusive examples of accomplishments and plans for projects funded in this activity:<br><br>***FY 2013 Accomplishments:***<br>Human Computer Interaction/Visualization:<br>- Continued application of cognitive architecture modeling to the design of interface analysis tools.<br>- Continued 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.<br>- Continued effort to develop tools for more automated, cost-efficient modeling of human system interaction.<br>- Continued development of a testbed for validating cognitive models of operator performance in cross-modal (audio/visual) task environments.<br>- Continued development of the multitasking and metacognitive components of the Tactical Action Officer (TAO) model, especially as they apply to dual-tasks involving "chat" style instant-messaging interleaved with other watchstanding duties.<br>- Continued development of spatialized 3D-audio displays to mitigate cognitive load during the performance of dual-tasks.<br>- Continued investigation of human attentional limitations in understanding sped-up and serialized speech over multiple radio channels.<br>- Continued development of cognitive-model-based predictors of operator error in procedural tasks.<br>- Continued development of cognitive models of the TAO to be utilized within a virtual, Combat Information Center (CIC) simulated environment.<br>- Continued investigation of auditory attentional effects on watchstanding activities, especially in the context of monitoring multiple radio channels. Results will be used to provide recommendations for new communications protocols. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of cognitive models of user interface affordance that could form the basis of usability analysis and evaluation.<br><br>Collaboration and Knowledge Interoperability:<br>- Completed evaluation of Latent Semantic Analysis (LSA) of operator communications as an effective metric of shared situational awareness in unmanned aerial vehicle control teams.<br>- Completed 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 solving complex problems.<br>- Completed 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.<br>- Completed 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.<br>- Completed 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.<br>- Completed development of metrics to identify and measure the contribution to team performance of the cognitive processes underlying ad-hoc team decision making.<br>- Completed effort to improve the model of ad-hoc team decision making by including collaborative agent-based contribution to team Performance.<br>- Completed test and validation of a cognitive processes model of team collaboration in a Maritime Interdiction Operations domain.<br>- Completed integration of high-level planning and computational cognition with low-level input to enhance situational awareness via swarm-based sensor platforms.<br>- Completed 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.<br>- Completed 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.<br>- Completed development of a performance measurement testbed for assessing the contribution of high level cognitive (macrocognitive) processes to collaboration effectiveness and team performance in special operations intelligence analysis.<br>- Completed validation of computational team collaboration performance metrics for quick response teams, such as maritime interdiction operations and non-combatant evacuation operations.<br>- Completed development of a computational model of teamwork, however, shifted emphasis with issuing of two new grants. CMU will develop and apply novel machine learning algorithms to enable automated discourse analysis in order to identify | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| teamwork processes and corresponding emergent leaders, and OSU will develop proxy agent technology to improve information exchange between emergent leaders and subordinates.<br>- Completed development of metrics to measure team mental model convergence in order to assess teamwork performance in relation to mission success/outcome in submarine Command and Control. Shift emphasis to directly apply metrics to transition into the Capable Manpower Future Naval Capability.<br>- Completed development of the computational aspects of a model of tactical team decision making.<br>- Completed inclusion of the theoretical aspects of group cognition and knowledge building into the model of macrocognition.<br>- Completed development of computational model of teamwork, with increased emphasis on agile management of mission objectives and team tasking.<br>- Completed task management algorithms applicable to agile supervisory control of teams involving human and autonomous agents.<br><br>Organizational Design and Decision Support Systems:<br>- Completed 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.<br>- Completed jointly with the Air Force applied research on the integration of Information Operations in Air Control Centers.<br>- Completed applied research on command and control adaptive architectures for Expeditionary Strike Groups working with OPNAV and Expeditionary Strike Group ONE, San Diego.<br>- Completed research on quantitative formalisms for developing and assessing the completeness, consistency and accuracy of rules of engagement (ROEs).<br>- Completed 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.<br>- Completed research on models to support the design of scalable, joint and coalition Maritime Operations Centers that allocate responsibilities to elements afloat and ashore.<br>- Completed in cooperation with the Air Force, the capability to examine human competency requirements in offensive and defensive cyber operations, and the effects of courses of action at the tactical and operational level. The research was conducted using DoD and academic laboratories capable of high fidelity mission simulation and precise measurements of independent and dependent measures.<br>- Completed developing cooperatively with the Air Force a series of networked laboratories for hybrid, human-agent experimentation on multi-echelon decision making and adaptive architectures for large maritime operations centers.<br>- Completed model-based simulations and experiments to investigate effectiveness of hierarchical organizational structures in network centric operational environments, with increased emphasis on modeling of tasks and information requirements for rapid mission planning and re-planning. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Completed research on adaptive command and control architectures in support of the Navy's new Maritime strategy, with increased emphasis on dynamic task allocation based on mission phase and emergent mission requirements, and impact to information requirements.<br>- Completed development of Battlespace On Demand Decision Making for Meteorological and Oceanographic Command Decision making, with increased emphasis on development of piracy prediction decision support and uncertainty characterization.<br>- Completed research on development decision support tools for MOC, with increased emphasis on coordination across echelons in support of "Minesweeper to MOC" operations.<br>- Completed research for design of Maritime Headquarters (MHQ) with MOC organizations, with increased emphasis on design of information management tools and algorithm development for information prioritization.<br><br>Social Network Analysis:<br>- Continued development of new threat scenarios incorporating Joint Force Maritime Component Commander operations, and counterinsurgency 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.<br>- Continued development of Dynamic Network analysis (a terrorist network analysis tool) in an operational command setting at U.S. Pacific Command.<br>- Continued improvement of terror network analysis decision tools for combatant command use and military planning, including testing of tools, development of metrics, and validation.<br>- 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.<br>- Continued development of social network models to model the human element in maritime domain awareness.<br>- Continued 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).<br>- Continued human cultural and social modeling to improve warfighting, civilian military operations and humanitarian operations in non-Western environments.<br>- Continued social complexity modeling for community dynamics (Stabilization, Security, Transition and Reconstruction problems (SSTR) and Humanitarian Assistance/Disaster Relief (HA/DR)), an outgrowth of computational social science/social network analysis in non-Western settings.<br>- Continued new techniques for model development fundamentals.<br>- Continued development of geo-spatial aspects of data presentation, modeling and visualization for improving decision tools in SSTR and HA/DR.<br>- Continued information operations research on non-Western communities.<br>- Continued new methods to analyze, partition and filter massive datasets..<br>- Initiated new natural language prcessing methods to facilitate massive data collection using social media. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiated novel data collecting methods for SSTR and HA/DR.<br>***FY 2014 Plans:***<br>All FY 2014 Plans and Accomplishments transferred to PE 0602236N.<br>***FY 2015 Plans:***<br>N/A | | | |
| ***Title:*** MULTI-SOURCE INTEGRATION AND COMBAT IDENTIFICATION<br>***Description:*** 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.<br><br>The decrease from FY 2013 to FY 2014 is due to the completion of Radar and Surveillance supporting Multi-Source Integration and Combat Identification.<br><br>The following are non-inclusive examples of accomplishments and plans for projects funded in this activity:<br>***FY 2013 Accomplishments:***<br>- Continued development of a new radar signature analysis technique based on nonlinear dynamics.<br>- Continued development of coordinated, multi-platform, multi-component waveforms.<br>- Continued development of a real-time, electronic warfare support, de-interleaving capability.<br>- Continued development of advanced communications emitter identification.<br>- Continued to develop and demonstrate Multiple Input Multiple Output (MIMO) radar concepts and technology using High Frequency (HF) Skywave radar.<br>- Continued development of functional classification techniques of advanced threat emissions.<br>- Continued development of unique tactical feature derivation of modern surveillance systems.<br>- Continued development of electronic protection techniques for long range emitter classification systems.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013.<br>- Complete development of functional classification techniques of advanced threat emissions.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014 unless otherwise noted as complete. | 4.437 | 2.742 | 2.882 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete development of unique tactical feature derivation of modern surveillance systems. | | | |
| ***Title:*** TACTICAL SPACE EXPLOITATION | 3.952 | 4.322 | 6.265 |
| ***Description:*** 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 by taking advantage of the global access, revisit and connectivity provided by orbital platforms.<br><br>a) Spacecraft Technology: Affordably expendable payload and bus technologies will be developed, which 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.<br><br>The increase in funding from FY 2014 to FY 2015 reflects initiation of new efforts and planned funding profile of existing efforts within this activity.<br><br>The following are non-inclusive examples of accomplishments and plans for projects funded in this activity:<br><br>***FY 2013 Accomplishments:***<br>Spacecraft Technology:<br>- 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.<br>- Continued effort to develop technologies using autonomous, bi-dexterous manipulation for close proximity operations in space.<br>- Continued developing the underlying fluid transfer technologies for steerable radiators that will enable spacecraft thermal radiators to be pointed away from the sun.<br>- Continued developing a proof-of-concept, reliable, touch sensitive skin for robotic arms, with emphasis on space applications, and the associated fault detection and model identification algorithms required to utilize it.<br>- Continued developing the ability to artificially generate and maintain a dust layer in the near-earth plasma environment to induce enhanced drag on space debris, aiming toward debris mitigation.<br>- Continued effort to design, develop and test a novel PicoSat-compatible spacecraft attitude sensor that is based on an existing NRL-designed space weather spectrometer, which will enable PicoSat-class missions requiring continuous day/night operations.<br>- Continued effort to develop a self-contained, space-based plasma impedance probe innovative sensor that will be easy to mount and field on any space platform, which will provide reliable early warning of hazardous spacecraft charging.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013.<br>Spacecraft Technology: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete effort to design, develop and test a novel PicoSat-compatible spacecraft attitude sensor that is based on an existing NRL-designed space weather spectrometer, which will enable PicoSat-class missions requiring continuous day/night operations.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014 unless otherwise noted as complete.<br>Spacecraft Technology<br>- Complete effort develop a self-contained, space-based plasma impedance probe innovative sensor that will be easy to mount and field on any space platform, which will provide reliable early warning of hazardous spacecraft charging. | | | |
| ***Title:*** INFORMATION SECURITY RESEARCH<br>***Description:*** The overarching objective of this activity is to protect the Navy and the Joint information infrastructure from hostile exploitation and attack. This activity transfers from PE 0603235N effective FY 2013 to focus on applied research in information security.<br><br>The current specific objectives are:<br>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.<br>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.<br>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.<br>The following accomplishments and plans are non-inclusive examples of accomplishments and plans for projects funded in this activity.<br><br>***FY 2013 Accomplishments:***<br>Network Situation Awareness & Security:<br>- Continued development of algorithms/methods for providing attribution of threat-agents through the network/infrastructure. Emphasis will be placed on addressing translational boundaries, cross-domains, and obfuscation techniques to avoid detection and tagging.<br>- Continued development of new algorithms to link/mine disparate system/network activities in order to identify malicious/threat agent actions against infrastructure components/systems.<br>- Initiated new mobile agent technology that provides network protection, thwarts botnet attacks, and provides for a resilient computational infrastructure and communications environment. Investigate new methods for subverting the control plane of the mobile code attacking the infrastructure. | 1.715 | 2.002 | 2.060 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Network Traffic Analysis and Assessment:<br>- Continued development of new algorithms focused on detection of nation state sponsored activities through the network infrastructure.<br>- Initiated algorithms to address sophisticated malicious code techniques that exploit network traffic/data that is fragmented, encrypted, and/or obfuscated using polymorphic methods, as well as techniques that transgress security perimeters and exfiltrate data.<br><br>Information Assurance:<br>- Continued enclave boundary security controller to protect Navy networks from attack and exploitation with emphasis on addressing malware detection, data exfiltration, general attack detection, network reconstitution, exploitable cross-infrastructure dependencies.<br><br>***FY 2014 Plans:***<br>Network Situation Awareness & Security:<br>- Continue development of algorithms/methods for providing attribution of threat-agents through the network/infrastructure. Building upon previous results, develop network-based techniques to provide pro-active response to attributed threat agents to mitigate attack vector and ensure mission success.<br>- Continue investigating new methods for subverting the control plane of the mobile code attacking the network infrastructure. Initiate the development of new algorithms for taking control of bots once the control plane is compromised.<br>- Complete development of algorithms to link/mine disparate system/network activities in order to identify malicious/threat agent actions against infrastructure components/ systems. Expand algorithms to include threat-agent identification.<br>- Initiate development of new algorithms/techniques to characterize Navy and Marine Corps network assets in order to develop robust security mechanisms and support technologies based on criticality and mission essential operations.<br><br>Network Traffic Analysis and Assessment:<br>- Continue development of new algorithms focused on detection of nation state sponsored activities through the network infrastructure. Develop algorithms to address sophisticated malicious code techniques.<br>- Initiate development of new algorithms that provide attack prediction and targets of opportunity.<br><br>Information Assurance:<br>- Complete development of the enclave boundary security controller to protect Navy networks from attack and exploitation with emphasis on addressing malware detection, data exfiltration, general attack detection, network reconstitution, exploitable cross-infrastructure dependencies. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate development of methods and techniques to provide component repurposing/agility to flatten the attack surface from sophisticated nation-state sponsored attacks.<br><br>***FY 2015 Plans:***<br>N/A | | | |
| ***Title:*** AUTONOMOUS SYSTEMS AND ROBOTICS<br><br>***Description:*** The Autonomous Systems and Robotics initiative explores the application of new technologies to advance capabilities in the area of robotics, autonomous systems propulsion and control, and integration of autonomous systems. Efforts will be focused on the Assistant Secretary of Defense (Research and Engineering) (ASD(R&E)) priorities in autonomous systems.<br><br>FY13 funds are for acceleration efforts in Autonomous Systems and Robotics.<br><br>The decrease from FY 2013 to FY 2014 is due to the completion of initial stand-up activities in FY 2013 for the Autonomous Systems and Robotics initiative.<br><br>***FY 2013 Accomplishments:***<br>Robotics Platform Research:<br>This addresses development of autonomous robotic systems capability to interact with and service other platforms and autonomous vehicles.<br><br>Micro-Robotic Servicing - advanced highly dexterous control of extremely lightweight and flexible robotic arms, with specific application to EOD, surveillance and on-orbit servicing robotic communities. This research would extend ongoing research in lightweight robotic arms.<br><br>Autonomous Refueling - development of hardware, algorithms, and sensors for hybrid rigid-compliant robotic arms in rapidly changing environments, with specific application to autonomous refueling of USVs, UAVs and UGVs while moving in their environments, advancing beyond the DARPA-sponsored "Rapid Autonomous Fuel Transfer Project".<br><br>Low Power Micro-robotics - development of onboard sensors, control electronics, and actuators requiring very low power, with specific application to robotic missions over long durations.<br><br>Advanced Manipulators and Tool-Changers - development of innovative robotic manipulators, tool changers, and associated sensors for challenging robotic manipulation tasks, with specific application to EOD and other robotic missions in difficult environments. This research would extend previous research by providing robust end effector technology and tool changing | 5.444 | 1.981 | 1.972 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| capability. The overall research outcomes will enhance DoD capability in the areas of explosive ordnance disposal, autonomous vehicle refueling, and innovative robotic arm control. Research deliverables will include hardware development in the areas of lightweight robotic arms, end effector tools and tool changers, and low power electronics and actuators.<br><br>Autonomous Vehicles:<br>- This effort will draw from current research and push the technology development to the next level to provide a leap-ahead capability in long endurance, deployable, autonomous, robotic air vehicle using fuel cell electric propulsion systems for high efficiency, even in small vehicles, which can provide robust airborne sensor capabilities for submarines, UUVs, small naval platforms and small dismounted units.<br><br>Undersea Vehicles:<br>- Funding would be used to acquire a medium sized (12.5 inch diameter) Autonomous Underwater Vehicle as an at sea test platform to advance the state of art of onboard intelligent autonomy. This medium sized UUV is readily amenable to vehicle and sensor testing in the wave pool in the Laboratory for Autonomous Systems Research facility. Subsequently, this would allow at sea testing of State of the art autonomy algorithms (e.g. goal driven autonomy, human cognitive models, Markov decision processes) that allow Navy underwater vehicles to carry out complex mission in denied areas by understanding the environment and adapting mission goals in the context of the commander's intent, with little or no human operator intervention.<br><br>Autonomous Systems Integration:<br>- To support the Assistant Secretary of Defense (Research and Engineering) (ASD(R&E)) priorities in autonomous systems, and specifically to advance the state of the art in heterogeneous teams of autonomous platforms, (including sensor networks and mobile communication nodes) that can work seamlessly with the warfighter, funding will be applied to small air platforms and militarily relevant unmanned ground vehicles to integrate sensors and advanced power sources, and to develop the autonomy software that allows the individual platforms to work together, as well as to work at a peer-to-peer level with the warfighter. This includes advanced human-robot interaction techniques and information processing and presentation techniques that reduce the warfighter's cognitive load and allows him to work with a team of autonomous systems.<br><br>***FY 2014 Plans:***<br>Continue all FY 2013 efforts and sustainment of Autonomous Systems and Robotics initiative.<br><br>***FY 2015 Plans:***<br>Continue all FY 2014 efforts. | | | |
| **Accomplishments/Planned Programs Subtotals** | 37.643 | 34.136 | 43.541 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602235N / *Common Picture Applied Research* | **Project (Number/Name)**<br>0000 / *Common Picture Applied Research* |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

This PE supports the development of technologies that enable the transformation to network centric warfare. Net-centric operations include communications and information assurance capabilities to enable all-source data access, tailored dissemination of information to Command and Control (C2) and Intelligence, Surveillance and Reconnaissance (ISR) users across the network, and rapid, accurate decision making based on this information. 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.

Specific examples of metrics under this PE include:
- Increase network data rates and interoperability across heterogeneous radios; improve dynamic bandwidth management and mobile network connectivity.
- Increase the understanding of the battlespace by the development of automated tools for extracting information from images and signals, identifying objects, determining relationships among the objects, assessing intent, and generating courses of action.
- Improve the integration of sensors, networks, decision aids, weapons, and supporting systems into a highly adaptive, human-centric, comprehensive maritime system.
- Improve integrated signals electronics packages in small, light-weight, and low-cost satellites to test new concepts for global ship tracking and two-way data exfiltration.

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | | | | | R-1 Program Element (Number/Name)<br>PE 0602236N *I Warfighter Sustainment Applied Res* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 40.162 | 49.688 | 46.923 | - | 46.923 | 44.755 | 46.178 | 46.980 | 47.077 | Continuing | Continuing |
| 0000: *Warfighter Sustainment Applied Res* | 0.000 | 40.162 | 49.688 | 46.923 | - | 46.923 | 44.755 | 46.178 | 46.980 | 47.077 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

FY 2013 funding associated with Future Naval Capability (FNC) efforts are transferring to a new Program Element titled Future Naval Capabilities Applied Research (PE 0602750N). This is to enhance the visibility of the FNC Program by providing an easily navigable overview of all 6.2 FNC investments in a single location.

**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 (Sep 2011). 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 innovation-based efforts that will provide technology options for future Navy and Marine Corps capabilities. Efforts focus on advanced Naval materials; biocentric technologies; environmental quality; human factors and organizational design; medical technologies; and Naval training technologies. Within the Naval Transformation Roadmap, this investment maps to future transformational capabilities and the FORCEnet pillar of the Chief of Naval Operations and the Commandant of the Marine Corps vision for the future -- Naval Power 21.

The ONRG International Science Program mission is to search the globe for emerging scientific research and advanced technologies to enable the Office of Naval Research (ONR) and the NRE to address effectively the current needs of the Fleet/Forces, and investigate and assess revolutionary, high-payoff technologies for future Naval missions and capabilities. Within this Global mission, funding for the Naval Science Advisor Program ensures the Fleet/Force (F/F) helps shape the Department of the Navy (DoN) investment in Science and Technology (S&T), develops teaming relationships to rapidly demonstrate and transition technology, supports development of technology-based capability options for naval forces, and enables warfighting innovations based on technical and conceptual possibilities. Science Advisors provide insight into issues associated with Naval Warfighting Capabilities that influence S&T program decision making. The program develops leaders among civilian scientists and engineers in the Naval Research Enterprise (NRE). Upon completion of their tours, Science Advisors return to the NRE with first hand knowledge of the F/F, warfighting issues, and strategic decision making. The Office of Naval Research (ONR) Science Advisor program enables continuous communication and collaboration between the warfighters, the technical community, and strategic development commands.

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | **R-1 Program Element (Number/Name)**<br>PE 0602236N *I Warfighter Sustainment Applied Res* |

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 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 44.127 | 49.689 | 48.950 | - | 48.950 |
| Current President's Budget | 40.162 | 49.688 | 46.923 | - | 46.923 |
| Total Adjustments | -3.965 | -0.001 | -2.027 | - | -2.027 |
| • Congressional General Reductions | - | -0.001 | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | - | - | | | |
| • SBIR/STTR Transfer | -0.246 | - | | | |
| • Program Adjustments | - | - | -2.012 | - | -2.012 |
| • Rate/Misc Adjustments | - | - | -0.015 | - | -0.015 |
| • Congressional General Reductions Adjustments | -3.719 | - | - | - | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 2 | R-1 Program Element (Number/Name)<br>PE 0602236N / *Warfighter Sustainment Applied Res* | Project (Number/Name)<br>0000 / *Warfighter Sustainment Applied Res* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000: *Warfighter Sustainment Applied Res* | - | 40.162 | 49.688 | 46.923 | - | 46.923 | 44.755 | 46.178 | 46.980 | 47.077 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

This PE supports the FNCs 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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** ADVANCED NAVAL MATERIALS | 21.182 | 10.737 | 9.680 |
| ***Description:*** Advanced Naval Materials efforts include: developing advanced, high-performance materials; developing processes to reduce weight and cost; and developing enhanced sonar transducers.<br><br>The Office of Naval Research Global (ONRG) has a presence overseas, and a mission to search the globe for promising, emerging scientific research and advanced technologies to enable the Office of Naval Research to effectively address current needs of the Fleet and Force. This includes discovering the best science, such as innovative fundamental research which could help shape future naval investments and strategies, and leveraging great minds globally with positive engagement to support the Sailors & Marines of today and tomorrow.<br><br>The decrease of funding from FY 2013 to FY 2014 is due to the consolidation of international research efforts into a new R2 activity within this PE entitled ONR Global. This new R2 activity provides greater visibility for Naval international collaboration and research efforts.<br><br>The decrease of funding from FY 2014 to FY 2015 is due to a ramping down of the effort for Light Weight Ballistic Protection for Maritime Security Forces. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***FY 2013 Accomplishments:***<br>- Continued multi-laser-processing technique development for the fabrication of ultra hard materials for wear resistance applications.<br>- Continued development of advanced, cost-efficient joining of titanium for >25% weight reduction of large seaborne structures.<br>- Continued development of acceptance testing methodologies for advanced transducer, single-crystal, high-strain materials and definition of standardized materials properties and composition ranges.<br>- Continued development of compositional tuning of single-crystal, high-strain transducer materials, for specialized naval system applications.<br>- Continued development of cavitation resistant ship rudder coatings based on the FY 2004 shipboard coating study.<br>- Continued marine titanium alloy design and processing development, exploiting anticipated cost reductions for high performance, reduced maintenance naval applications.<br>- Continued development of continuous, single wall, carbon nanotube composite materials for next generation air and naval platforms.<br>- Continued stainless steel carburization study to enhance corrosion performance.<br>- Continued development of surface preparation methods and characterization of corrosion performance for future naval ship materials.<br>- Continued evaluation of low temperature, carburized materials for marine application.<br>- Continued development of coating performance and knowledge database for Naval use.<br>- Continued development of mechanistic model for stress corrosion cracking in Nickel Aluminum Bronze (NAB).<br>- Continued development of innovative sonar transducers based on high-strain, high-coupling, piezoelectric single crystals.<br>- Continued development of integrated structural composites with blast resistance, manufacturing technologies, and low-cost organic resins with improved fire resistance.<br>- 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.<br>- Continued development of models and characterization methods for dynamic loading (water slamming and blast loading) in polymer composite materials.<br>- Continued acoustic damping coatings for ship tank application.<br>- Continued development of portable, real-time, Non-Destructive Examination (NDE)/Non-Destructive Inspection (NDI) technology for heat damage detection in composite materials.<br>- Continued development of fiber-optic sensors, transducers and demodulation technology for structural health monitoring of ships and submarines.<br>- Continued development of continuous based monitoring techniques of new synthetic fuels and lubricants based on electromagnetic signature analysis. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development and application of distributed fiber optic Bragg gratings for structural health monitoring of ships and aircrafts.<br>- Continued development of novel growth methods to specialized single crystal transducer materials tuned to requirements of specialized naval systems.<br>- Continued assessment of the degree of sensitization potential of marine grade Al alloys.<br>- Continued investigation of criteria for stable pitting of stainless steel.<br>- Continued development of surface assessment technologies to measure surface profile and chlorine.<br>- Continued evaluation of advanced material coating for erosion control on helicopter main rotor blade leading edges.<br>- Continued development of seamless joining technologies for large, complex shaped conventional ceramic windows from small, inexpensive components using electrophoretic deposition of ceramic nanoparticles.<br>- Continued development of intelligent corrosion sensor systems for intergranular corrosion cracking.<br>- Continued studies on fuel cell corrosion.<br>- Continued development of superhydrophobic surface modification technology.<br>- Continued studies on mitigation of pitting corrosion and stress corrosion cracking in marine aluminum alloys.<br>- Continued development of surface tolerant coating removal methods.<br>- Continued development of processing technologies to fabricate piezoelectric single crystals into complex transducer assemblies.<br>- Continued development of thermal management system(s) to arrest excessive heat fluxes and loads on amphibious ship by advanced Naval/USMC aircraft.<br>- Continued development of MEMS based sensor nodes, with energy harvesting and wireless communication capabilities, for system health management and prognosis.<br>- Continued development of high-strength, high-hardness tool materials for friction-stir welding applications.<br>- Continued development of the rational engineering design of Al-alloys for naval applications.<br>- Continued to Iincrease emphasis on research efforts to discover innovative fundamental technologies to shape future Naval investments and strategies, leveraging the globe to support the Sailors & Marines of today and tomorrow.<br>- Continued development of quantitative coasting quality assurance tools.<br>- Completed development of materials processing methods for single crystal piezoelectrics to make strong, robust sonar transducers.<br>- Completed development of advanced composites and polymers with fire resistance for ship structures.<br>- Completed development of nanotube reinforced composite materials for next generation air and naval platforms.<br>- Increased emphasis on research efforts to discover innovative fundamental technologies to shape future Naval investments and strategies, leveraging the globe to support the Sailors & Marines of today and tomorrow.<br>- Initiated study of fluid-structure fynamics for flexible body armor. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiated development of mixed metal nanopowder additives for liquid fuels.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Complete development of seamless joining technologies for large, complex shaped, conventional ceramic windows from small, inexpensive components using electrophoretic deposition of ceramic nanoparticles.<br>- Complete developing techniques for processing of nanostructured aluminum alloys and composites which do not require use of liquid nitrogen.<br>- Complete development of high-strength, high-hardness tool materials for friction-stir welding applications.<br>- Complete development of MEMS based sensor nodes, with energy harvesting and wireless communication capabilities, for system health management and prognosis.<br>- Complete development of portable, real-time, non-destructive examination (NDE)/Non-destructive Inspection (NDI) technology for heat damage detection in composite materials.<br>- Complete development of integrated structural composites with blast resistance, manufacturing technologies, and low-cost organic resins with improved fire resistance.<br>- Complete development of continuous single wall carbon nanotube composite materials for next generation air and naval platforms.<br>- Complete development of energy efficient scalable processing of low cost titanium alloys.<br>- Initiate development of advanced NDE, SHM and Prognostics Technologies for improved readiness and reliability of air and naval platforms based on new and emerging electronic and photonics materials and devices.<br>- Initiate development of advance structural composites with improved mechanical characteristics, blast resistance, and fire resistance, for more durable and reliable structures by optimizing the resin, the fibers and the interphases with new chemistries, additives and processes.<br>- Initiate development and exploitation of new and advanced forms of carbon based nanostructures (Graphene, Nanotubes, Diamond and others) for next generation family of materials and structures with outstanding mechanical, thermal, electrical and energy applications.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Complete multi-laser-processing technique development for the fabrication of ultra hard materials for wear resistance applications.<br>- Complete development of advanced, cost-efficient joining of titanium for >25% weight reduction of large seaborne structures.<br>- Complete development of cavitation resistant ship rudder coatings based on the FY 2004 shipboard coating study. | | | |
| ***Title:*** BIOCENTRIC TECHNOLOGIES | 6.116 | 6.470 | 6.045 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

***Description:*** Biocentric technologies provide novel solutions for naval needs based upon the applications of bio-inspiredsensors, materials, processes and systems. Topic areas include, but are not limited to development of biologically-based signal processing for medical, surveillance and security applications; bioinspired robotics; synthetic biology to produce high-value naval materials or to develop sentinel organisms, and marine mammal diagnostics to support the Navy's Fleet Marine Mammal Systems.

***FY 2013 Accomplishments:***

Naval Biosciences:
- 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 and AUV's.
- Completed efforts on naval biosensor to detect brain structures and blood vessels through skull bones.
- Completed studies of production of high-value naval material (e.g., fuels, conducting polymers).
- Initiated studies of microbial fuel cells for shoreside or shipboard applications.

Synthetic Biology for Sensing & Energy Production:
- Continued long duration, realistic field tests, and modeling studies of autonomous microbial fuel cell power systems for underwater sensor networks.
- Initiated synthetic biology studies of engineered sentinel organisms for environmental surveillance and production of high-valued naval materials (e.g., fuels, conducting polymers).

Life Sciences and Bioengineering:
- Continued development of a second set of molecular diagnostic tests for recently discovered viral, bacterial, and fungal pathogens of marine mammals.
- Continued marine mammal diagnostics efforts, including immunobioassays for stress and infection detection.
- Continued effort to evaluate breath analysis for non-invasive diagnostics in marine mammal medicine.
- Continued efforts to engineer plants to produce energetic materials.
- Completed studies to evaluate candidate probiotics in Altantic bottlenose dolphins.
- Completed studies of dolphin regenerative cells for treating a variety of pathologies and disease states in these animals.
- Initiated microbe derived production of aviation fuel components from renewable wastes.
- Initiated efforts to detect, treat, and prevent diseases in dolphins, including diabetes and kidney stones.

Neural, Sensory and Biomechanical Systems:

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued efforts on advanced biomimetic sensing and neural control for human-robot interaction to enable effective collaboration of warfighters and autonomous systems.<br>- Continued integration of biomimetic sonar with bioinspired autonomous undersea vehicles (with high-lift propulsors) to achieve closed loop control.<br>- Continued efforts in bioinspired quiet, and maneuverable self-propelled line array using high-lift propulsors based on animal wing and fin biomechanics.<br>- Continued efforts for bio-inspired massively parallel vision systems.<br>- Completed effort to develop living fluidic networks.<br>- Initiated studies to develop brain-based intelligent systems to support high level interaction between warfighters and autonomous systems. | | | |
| ***FY 2014 Plans:***<br>Naval Biosciences:<br>- Continue all efforts of FY 2013, less those noted as completed above.<br><br>Synthetic Biology for Sensing & Energy Production:<br>- Continue all efforts of FY 2013.<br><br>Life Sciences and Bioengineering:<br>- Continue all efforts of FY 2013, less those noted as complete above.<br>- Complete development of a second set of molecular diagnostic tests for recently discovered viral bacterial, and fungal pathogens of marine mammals.<br><br>Neural, Sensory and Biomechanical Systems:<br>- Continue all efforts of FY 2013, less those noted as completed above. | | | |
| ***FY 2015 Plans:***<br>Naval Biosciences:<br>- Continue all efforts of FY 2014.<br><br>Synthetic Biology for Sensing & Energy Production:<br>- Continue all efforts of FY 2014.<br><br>Life Sciences and Bioengineering:<br>- Continue all efforts of FY 2014, less those noted as completed above. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete microbe derived production of aviation fuel components from renewable wastes.<br><br>Neural, Sensory and Biomechanical Systems:<br>- Continue all efforts of FY 2014.<br>- Initiate studies to develop electrosence and biosonar for MOC and EOD missions. | | | |
| ***Title:*** ENVIRONMENTAL QUALITY | 2.652 | 2.837 | 2.846 |
| ***Description:*** 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.<br><br>***FY 2013 Accomplishments:***<br>- Continued development of new, advanced, environmentally benign AF/Anti-Corrosive (AC) costing systems for Navy platforms.<br>- Continued development of advanced environmentally sound technologies for shipboard waste treatment and pollution abatement systems.<br>- Continued development and modifications to shipboard oily waste treatment systems to accommodate processing of synthetic lubricants.<br>- Continued field evaluation of prototype robotic Hull BUG to identify gaps needed to refine and advance the technology.<br>- Continued 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.<br>- Continued efforts on improved handheld, waterborne, underwater hull cleaning technologies.<br>- Continued studies on oil emulsion issues and development of novel bilge water treatment systems on existing and new ships.<br>- Completed development and modifications to shipboard oily waste treatment systems to accommodate processing of sythetic lubricants.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014.<br>- Complete efforts on improved handheld, waterborne, underwater hull cleaning technologies. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete 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. | | | |
| ***Title:*** HUMAN FACTORS AND ORGANIZATIONAL DESIGN | - | 5.338 | 5.412 |
| ***Description:*** 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 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:<br><br>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.<br><br>b) Command Decision Making (CDM): This is a new sub-project that consolidates the previous Collaboration and Knowledge Interoperability (CKI) and Organizational Design and Decision Support Systems sub-projects. The CDM sub-project is focused at the development of dynamic decision support systems that recognize and are responsive to changing mission and task demands, and adapt to present information appropriately. This focus is explicitly intended to deliver decision support that will be more timely and responsive to rapidly evolving operational needs. Current thrusts within the sub-project are to: 1) Conduct research on the application of theory to exploit relevant information for effective decision making; 2) Develop models that are operationally context and task sensitive; 3) Study and apply research for the effective management of highly complex & time critical decision making; 4) Develop and demonstrate decision support tools that address the timely management of risk and uncertainty.<br><br>c) 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 | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

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

This FY 2014 activity funding moves from Program Element 0602235N: Common Picture Applied Research efforts associated with the Human Factors activity and is being transferring into this PE0602236N: Warfighter Sustainment Applied Research to provide an easily navigable overview of all Human Factors investments in a single location.

***FY 2013 Accomplishments:***
N/A

***FY 2014 Plans:***
Human Computer Interaction/Visualization:
- Continue all efforts of FY 2013.
- Initiate research on audio-visual cue integration for 360-degree periscope displays. Utilize eye-tracking, sleep studies and traditional behavioral measures to characterize human performance on periscope-related tasks under a variety of physiological conditions.

Command Decision Making (CDM):
- Continue all efforts of FY 2013 less noted above as complete.
- Develop task management algorithms applicable to agile supervisory control of teams involving human and autonomous agents.
- Initiate development of information infrastructure that is operational context sensitive to allow the dynamic prioritization of date based on its anticipated information value and mission criticality.

Social Network Analysis:
- Continue all efforts of FY 2013 less noted above as complete.
- Initiate research on socio-technical aspects of community mobilization and complex humanitarian operations, including the use of novel platforms, social networks and the impact of novel technologies on human behavior in crisis and collaborative contexts.

***FY 2015 Plans:***
Human Computer Interaction/Visualization:
- Continue all efforts of FY 2014.

Command Decision Making (CDM):

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts of FY 2014.<br>- Initiate research building proactive decision support tools for Command and Control.<br><br>Social Network Analysis:<br>- Continue all efforts of FY 2014.<br><br>Hybrid Human Computer Systems:<br>- Initiate research to address visualization and synthesis from multiple data sources to support autonomous systems and small hybrid teams.<br>- Initiate research on human performance sources of cyber vulnerabilities of UxV systems.<br>- Initiate research in human systems integration to reduce workload and increase operator situation awareness in command information center. | | | |
| ***Title:*** MEDICAL TECHNOLOGIES | 5.560 | 5.989 | 6.164 |
| ***Description:*** 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; including regenerative medicine technologies and therapeutic/restorative practices for the treatment of combat-related traumatic injuries. 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.<br><br>***FY 2013 Accomplishments:***<br>Undersea Medicine:<br>- Continued efforts to reduce operational injuries.<br>- Continued efforts to develop prophylactic agents preventing hyperbaric oxygen toxicity. Prolonged exposure to hyperbaric oxygen can be toxic to lungs, nervous system and eyes.<br>- 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.<br>- 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, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - 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.<br><br>Regenerative Medicine:<br>- Continued program, with Army, in regenerative medicine (Armed Forces Institute for Regenerative Medicine (AFIRM)).<br><br>Noise Induced Hearing Loss:<br>- Continued efforts to reverse NIHL.<br>- Continued studies related to biomedical effects of underwater sound. Military divers must operate safely and effectively in potentially complex underwater sound fields.<br>- Continued efforts for "stress inoculation" to mitigate the impact of exposure to stressful combat environments prior to deployment.<br>- Continued research to study the incidence and susceptibility of Noise Induced Hearing Loss (NIHL) and tinnitus, and to evaluate mitigation strategies.<br>- Continued research in prevention and treatment of NIHL and tinnitus (ringing in the ears).<br>- Continued research to improve personal protective equipment technology.<br>- Continued research to reduce noise at the source, i.e. jet engine quieting and flight deck noise reduction.<br><br>Noise Induced Hearing Loss-Jet Noise:<br>- Initiated Jet Noise Reduction Project, Noise Induced Hearing Loss Program, to utilize analytical modeling and simulation tools anchored by experiment to develop and assess solutions enabling mitigation of jet induced noise from high performance tactical aircraft. | | | |
| ***FY 2014 Plans:***<br>Undersea Medicine:<br>- Continue all efforts of FY 2013.<br>- Initiate research to explore novel pharmaceutical interventions for hyperbaric oxygen toxicity.<br><br>Regenerative Medicine:<br>- Continue all efforts of FY 2013.<br>- Complete program, with Army, in regenerative medicine (Armed Forces Institute for Regenerative Medicine (AFIRM)).<br>- Initiate program with Army, in regenerative medicine (Armed Forces Institute for Regenerative Medicine (AFIRM II)) | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Noise Induced Hearing Loss:<br>- Continue all efforts of FY 2013.<br><br>Noise Induced Hearing Loss-Jet Noise:<br>- Continue all efforts of FY 2013.<br>***FY 2015 Plans:***<br>Undersea Medicine:<br>- Continue all efforts of FY 2014.<br>- Initiate research on resuscitation therapies for near-drowning victims.<br><br>Regenerative Medicine:<br>- Continue all efforts of FY 2014, less those noted as completed above.<br><br>Noise Induced Hearing Loss:<br>- Continue all efforts of FY 2014.<br><br>Noise Induced Hearing Loss-Jet Noise:<br>- Continue all efforts of FY 2014. | | | |
| ***Title:*** THE OFFICE OF NAVAL RESEARCH GLOBAL<br><br>***Description:*** ONR has a presence overseas, with an overarching purpose to search the globe for promising, emerging scientific research and development efforts to address the current needs of the Fleet/Forces, and investigate high-payoff technologies for future naval missions and capabilities. To accomplish this task, ONR capitalizes on global innovation and investment to solve U.S. Navy and Marine Corps science and technology (S&T) challenges, builds global S&T awareness to mitigate risk of potential technological surprise, ensures Fleet/Forces capability needs are communicated to the Naval Research Enterprise (NRE), and facilitates delivery of Naval S&T solutions to the Fleet/Forces.<br><br>ONR Applied Research (6.2) requirements prior to FY 2014 were funded in another R-2 activity within this PE and also in PE 0602123N and 0206568N. Starting in FY 2014, these requirements have been consolidated into this separate R-2 activity to provide greater visibility for ONR international collaboration and research efforts.<br><br>The decrease from FY 2014 to FY 2015 is due to reprioritization of requirements. All efforts will continue to the greatest extent possible. | - | 13.287 | 11.881 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

***FY 2013 Accomplishments:***
N/A

***FY 2014 Plans:***
International Science Program:

The ONR International Science Program mission is to search the globe for emerging scientific research and advanced technologies, to enable the Office of Naval Research (ONR) and the Naval Research Enterprise (NRE) to effectively address current needs of the Fleet/Forces, and investigate and assess revolutionary, high-payoff technologies for future naval missions and capabilities. This is accomplished through PHD-level Associate Director scientists located in Asia, Europe and South America collaborating with international organizations and researchers through grants in innovative applied research, and establishing quality, relevant connections between international science and technology (S&T) centers of excellence and DON, DOD, and other US Government organizations. The direct impact of this investment is to capitalize on international applied research during unprecedented and dynamic global interdependence, increasing the ability to solve DON S&T challenges through shared knowledge and technologies with partners. Additionally, this investment builds global S&T awareness to reduce the risk of potential technological surprise, and supports theater security cooperation goals to sustain cooperative relationships with an expanding set of international partners and to enhance global security.

Fleet/Forces Science Advisors:

The Naval Science Advisor (SA) Program ensures the Naval Fleet/Forces shape the DON investment in applied research S&T, developing teaming relationships in support and development of technology-based capability options for Naval Fleet/Forces. Funding is also dedicated to applied research efforts in support of the various Naval Fleet/Forces operational commands.

The Science Advisors (SA) are a conduit between the Naval Fleet/Forces, ONR, Naval Research Lab (NRL) and the entire Naval Research Enterprise (NRE). Specific Fleet/Forces Science Advisors include the following:

- SA, Navy Warfare Development Command (NWDC), provides technical support for the generation and development of advanced warfighting concepts leading to innovative new strategies to address Navy challenges and opportunities.

- SA, CNO Strategic Studies Group (SSG) fully partners in the generation of revolutionary warfighting concepts for the Navy of the future. Along with the Technology Fellows, the SA develops the SSG Fall Program which includes researching and inviting lecturers to address the SSG and developing engaging and mind-opening exploration travel for the CNO Fellows and mini exploration travel for all SSG members.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

- SA, Chief of Naval Operations Code N81 (OPNAV N81) focuses on disseminating the Navy's warfighting capability/risk analysis products to the broader S&T community resulting in an improved influence of requirements pull on S&T. The N81

- SA, is part of the ONR internal strategy cell membership for updating the Navy S&T Strategic Plan.

- SA, Naval Mine and Anti-Submarine Warfare Command (NMAWC) works with the Commander NMAWC who is the lead for the FNC ASW sub-Integrated Program Team (IPT). The SA is directly responsible to the Commander for drafting/modifying capability gaps and enabling capabilities (EC) ideas, vetting them through the sub-IPT members, incorporating modifications, and providing the final recommendation to the Commander for presentation to the Sea Shield IPT. The SA advises Commander on Navy's Tactical ASW and MIW support and countermeasures.

***FY 2015 Plans:***

International Science Program:
- Continue all efforts of FY 2014.

Fleet/Forces Science Advisors:
- Continue all efforts of FY 2014.

- SA, OPNAV N2/N6 advises the Deputy CNO for Information Dominance, and Flag and SES leadership on Navy S&T programs that address information dominance; member of FNC Technical Oversight Group (TOG) Working Group which prioritizes and selects fifteen EC products that address nine FNC Pillars (i.e. FORCEnet, Sea Strike, Shield, and Basing); member of the FORCEnet IPT, Rapid Technology Transition Team, and Joint Concept Technology Demonstration Team that reviewed technology programs for the Fleet.

- SA, OPNAV N9, serves as the command's principal advisor and the senior representative of the DCNO on initiatives with S&T and Research and Development (R&D) organizations in government, academia, and industry. Advises on technical developments in support of platform warfighting wholeness and informs DCNO on strategic and program issues as they relate to topics in decision forums; and on S&T factors outside the normal Navy program planning process that could afford strategic opportunities or affect or disrupt existing strategies, investments and plans.

- SA, Commander, Navy Air and Missile Defense Command, (NAMDC) serves as the command's principal advisor and the representative of the Commander on Integrated Air and Missile Defense (IAMD) initiatives with S&T and R&D organizations in government, academia, and industry. The SA works as part of the Third Fleet Sea Shield Fleet Collaborative Team representing

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| NAMDC. The SA looks at the applied research and S&T aspects of IAMD and align them with the defense industry to pinpoint key requirements and emerging new technologies. | | | |
| ***Title:*** TRAINING TECHNOLOGIES | 4.652 | 5.030 | 4.895 |
| ***Description:*** 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, highstress, 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 achieved by applying operations research, modeling and simulation, and instructional, cognitive, and computer sciences to the development, delivery, evaluation, and execution of training.<br><br>***FY 2013 Accomplishments:***<br>Cognitive Science of Learning:<br>- Continued research and assessment of advanced gaming technology for enhanced training.<br>- Continued a systematic program of applied research addressing unanswered questions regarding effective instructional strategies in artificially intelligent tutoring.<br>- Continued research into computational neuron-models in the design of training systems.<br>- Continued field studies and user tests evaluating new features and job aiding tools.<br>- Continued creation and conduct of experiments to validate automated performance assessment and after action reviews.<br>- Initiated development of optimal training strategies for intelligent jobs on mobile devices ( e.g., IPad).<br>- Initiated development of immersive environments for training interpersonal and leadership skills.<br>- Initiated design and conduct experiment to assess training effectiveness of intelligent tutor for training ship handling skills.<br>- Initiated development of novel psychometric approaches to assess human performance in medical/ military simulations and simulators.<br>- Initiated research in design features of medical and military simulators and simulations.<br><br>Enhancing Warfighter Cognitive Capability:<br>- 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.<br>- Continued research to understand the structural relations among the latent variables of short-term memory, working memory, executive attentional control, and fluid intelligence.<br>- Continued research to assess the improvement in recruit classification provided by the addition of measures of fluid intelligence and working memory. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiated research to understand the role of intrinsic motivation in facilitating the transfer of working memory training to other cognitive capabilities.<br>- Initiated research to assess the efficacy of game-based brain training using hand-held (fieldable) hardware platforms.<br>- Initiated research to determine the relationship between induced gains in fluid intelligence and cognitive adaptability and agility, considered from the perspective of military decision-making.<br><br>Computational Models of Human Behavior:<br>- Continued the integration of cognitive and neuron-computational models of human learning.<br>- Continued research into game based training to more effectively enable better warfighter understanding of languages and cultures to enhance their regional expertise.<br>- Continued research on software tools to facilitate building natural language tutorial dialogs for artificially intelligent tutoring.<br>- Completed 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.<br>- Researched to create computational models of human behavior in selected non-Western environments that reflect the dominant cultural, social, ethnic, and economic determinates of behaviors, attitudes and beliefs of individuals, groups and organizations operating in these environments, and exploit these models to forecast responses to US actions and those of others attempting to exert influence over people in these environments.<br>- Developed multi-agent based architectures for modeling human behavior, improve techniques for human cognitive and behavioral modeling, and create highly realistic simulated team mates. | | | |
| ***FY 2014 Plans:***<br>Cognitive Science of Learning:<br>- Continue all efforts of FY 2013.<br>- Initiate research in the neuro-biology of learning including integration of the role of white matter.<br>- Initiate development of games that incorporate AI techniques to teach complex warefighter skills decision-making and problem solving.<br>- Initiate development of intelligent avatars to interact with learners from different cultural, linguistic backgrounds, and preferences.<br>- Initiate development of scenarios generators that produce integrated training (e.g., individual and collective) training.<br><br>Enhancing Warfighter Cognitive Capability:<br>- Continue all efforts of FY 2013. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602236N / *Warfighter Sustainment Applied Res* | **Project (Number/Name)**<br>0000 / *Warfighter Sustainment Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Computational Models of Human Behavior:<br>- Continue all efforts of FY 2013, less those noted as completed.<br>***FY 2015 Plans:***<br>Cognitive Science of Learning:<br>- Continue all efforts of FY 2014.<br><br>Enhancing Warfighter Cognitive Capability:<br>- Continue all efforts of FY 2014.<br><br>Computational Models of Human Behavior:<br>- Continue all efforts of FY 2014. | | | |
| **Accomplishments/Planned Programs Subtotals** | 40.162 | 49.688 | 46.923 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

As discussed in Section A, there are a significant number of varied efforts within this PE. Each effort is measured against both technical and financial milestones. Each program effort and its projects are reviewed in depth for technical and transition performance against established goals. The Program Managers conduct routine site visits to performing organizations to assess programmatic and technical progress and most projects conduct an annual or biannual review by an independent board of visitors who assess the level and quality of the Science and Technology (S&T) basis for the project.

THIS PAGE INTENTIONALLY LEFT BLANK

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | **R-1 Program Element (Number/Name)**<br>PE 0602271N *I Electromagnetic Systems Applied Research* |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Program Element | 0.000 | 73.985 | 97.690 | 107.872 | - | 107.872 | 136.737 | 116.073 | 125.258 | 124.068 | Continuing | Continuing |
| 0000: *Electromagnetic Systems Applied Research* | 0.000 | 73.985 | 97.690 | 107.872 | - | 107.872 | 136.737 | 116.073 | 125.258 | 124.068 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

FY 2013 funding and associated Future Naval Capability (FNC) efforts addressed in this Program Element (PE) are transferring to a new PE titled Future Naval Capabilities Applied Research (PE 0602750N). This is to enhance the visibility of the FNC Program by providing an easily navigable and consolidated overview of all 6.2 FNC investments in a single PE.

**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 (Sep 2011). 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.

Also included in this PE is the Netted Emulation of Multi-Element Signatures against Integrated Sensors (NEMESIS) Innovative Naval Prototype (INP). NEMESIS technology addresses the need to generate the appearance of a realistic naval force to multiple adversarial surveillance and targeting sensors simultaneously.

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, RDT&E Budget Item Justification: PB 2015 Navy | | | | | Date: March 2014 |
|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | | | R-1 Program Element (Number/Name)<br>PE 0602271N *I Electromagnetic Systems Applied Research* | | |
| **B. Program Change Summary ($ in Millions)** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO** | **FY 2015 Total** |
| Previous President's Budget | 78.228 | 97.701 | 90.783 | - | 90.783 |
| Current President's Budget | 73.985 | 97.690 | 107.872 | - | 107.872 |
| Total Adjustments | -4.243 | -0.011 | 17.089 | - | 17.089 |
| • Congressional General Reductions | - | -0.011 | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | 3.031 | - | | | |
| • SBIR/STTR Transfer | -0.731 | - | | | |
| • Program Adjustments | - | - | 3.652 | - | 3.652 |
| • Rate/Misc Adjustments | - | - | 13.437 | - | 13.437 |
| • Congressional General Reductions Adjustments | -6.543 | - | - | - | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 2 | R-1 Program Element (Number/Name)<br>PE 0602271N / *Electromagnetic Systems Applied Research* | Project (Number/Name)<br>0000 / *Electromagnetic Systems Applied Research* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000: *Electromagnetic Systems Applied Research* | - | 73.985 | 97.690 | 107.872 | - | 107.872 | 136.737 | 116.073 | 125.258 | 124.068 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** ELECTRONIC WARFARE TECHNOLOGY | 45.210 | 47.436 | 64.185 |

***Description:*** 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. Also included is technology development in support of the Integrated Distributed Electronic Warfare System (IDEWS) concept.

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.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| b) Components and Advanced Architectures/Signal Processing Designs:<br>Develop components and advanced architectures/signal processing designs to ensure effective and reliable threat detection of hostile emissions in dense environments.<br><br>c) Countermeasures and Techniques to Defeat Advanced Radio Frequency (RF) Guided Threats:<br>Develop countermeasures and techniques to defeat advanced 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.<br><br>d) Countermeasures and Techniques to Defeat Advanced Electro-Optic/Infrared (EO/IR) Guided Threats:<br>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.<br><br>e) Modeling and Simulation:<br>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.<br><br>f) Electronic Protection from Electromagnetic Interference (EMI) and EA:<br>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.<br><br>g) Offboard/Unmanned Platforms - Electronic Warfare:<br>Develop and demonstrate technologies that support the increased effectiveness of EW unmanned platforms.<br><br>h) Integrated Distributed Electronic Warfare System (IDEWS) concept: Develop and demonstrate technologies that will enable the control of the electromagnetic (EM) spectrum over wide geographical areas, optimally utilizing all available off-board and on-board EW assets to provide synchronized and networked EW sensing and attack.<br><br>i) Electronic Warfare (EW) Roadmap:<br>Develop classified advanced electronic warfare technology in support of current and predicted capability requirements. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| j) Wideband Electronic Support (ES) - Sensing/Processing:<br>Develop and demonstrate the capability of ES systems to provide wideband (1-110 gigahertz (GHz)) spectral coverage and improve naval (Navy and Marine Corps) battlespace awareness, which includes continuously monitoring this critical portion of the EMS; quickly and accurately classifying emitters and emitter functions; precisely and rapidly locating platforms, people, things, and events; and conducting accurate long-term monitoring and tracking of hostile forces.<br><br>k) Wideband Electronic Attack (EA) - Components/Techniques:<br>Develop and demonstrate the capability of EA systems to provide wideband (1-110 GHz) spectral coverage and improve naval (Navy and Marine Corps) ability to limit or deny enemy access to the EMS; provide false or misleading information to enemy C4ISR and targeting systems; and damage or degrade enemy sensing capabilities.<br><br>l) Millimeter Wave (MMW) High Power Transmitters:<br>To improve the capability of naval (Navy and Marine Corps) EA systems to deny or deceive sensors or weapons guidance systems operating in the MMW bands of the Electro-Magnetic Spectrum (EMS).<br><br>m) Multispectral Semiconductor Lasers: Develop and demonstrate a semiconductor-based, multi-wavelength integrated laser source spanning multiple bands of the ultraviolet (UV), visible (VIS), near infrared (NIR), short-wave infrared (SWIR), mid-wave infrared (MWIR), and long-wave infrared (LWIR) spectrum with multiple discrete spectral line emissions.<br><br>n) Continuously Tunable Multispectral Fiber/Waveguide Lasers: Develop and demonstrate a multi-wavelength integrated laser source with optical fibers/waveguides as the lasing media, spanning multiple bands of the UV, VIS, NIR, SWIR, MWIR, and LWIR spectrum with continuously tunable output emissions.<br><br>o) Non-Mechanical Beam Steering: Develop non-mechanical beam steering technologies that will allow coherent energy spanning multiple bands of the ultraviolet UV, VIS, NIR, SWIR, MWIR, and LWIR spectrum to be directed in a low divergence beam with minimal or no side lobes over an angular range covering not less than 120-degrees conical (threshold) up to a complete hemisphere (objective).<br><br>p) Enabling Cognitive and Adaptive Electronic Warfare: Apply adaptive and machine learning algorithms to EW.<br><br>q) Technologies for High Throughput and Rapidly Programmable EW Systems: Develop enabling technologies for reconfigurable EW systems that have extremely high-volume processing capability. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| r) Emulation Environments for Adaptive and Targeted Electronic Warfare: Develop emulated RF environments or modeling and simulation (M&S) environments to enable the development, testing, and validation of advanced cognitive and targeted EW techniques and systems.<br><br>Increase from FY 2014 to FY 2015 is due to:<br>- An increased emphasis on exploratory research into advanced technologies and techniques to counter emerging threats operating in higher bands of the radio frequency spectrum and utilizing extreme spectral and temporal agility.<br>- Added new scope to the Backfield project. This new effort under the EW Backfield project is to develop technologies to disrupt data links to pass information from hostile passive sensors to hostile engagement systems<br><br>The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.<br><br>***FY 2013 Accomplishments:***<br>Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest:<br>- Continued technology development in the areas of Tactical Aircraft, Surface Ships, Submarines, Unmanned Aerial Vehicles (UAVs), and EW Enabling Technology.<br>- Continued development of techniques to identify and exploit the processing vulnerability of passive location systems.<br>- Continued development of multi-spectral imaging capability in Short Wave Infrared (SWIR), Mid-Wave Infrared (MWIR) and Long-Wave Infrared (LWIR) spectral bands using a rugged common aperture.<br>- Continued advancing in the understanding of cognitive/software defined radios used in communications.<br>- Continued development of algorithms/techniques to provide additional/improved maritime domain awareness from existing sensor data.<br>- Continued progressing technology development in the area of network enabled coherent Electronic Warfare Support (ES).<br>- Continued progressing technology development in the area of coordinated coherent EA waveforms.<br>- Continued progressing development in cross-platform EA techniques.<br>- Continued progressing technology development in the area of wideband cueing receivers.<br>- Continued development of all-optical techniques for signal processing to provide multifunction RF capability.<br>- Completed Digital Directional Correlator (DDC) 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.<br>- Completed progressing technology development to detect and defeat passive sensing systems.<br>- Initiated development of a process to determine direction of arrival based on multipath distortion of the received emission.<br>- Initiated development of photonic techniques for broadband electronic surveillance systems.<br><br>Components and Advanced Architectures/Signal Processing Designs: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of RF technologies that support advances in receiver architecture, antenna performance, subsystem miniaturization, decoys and advanced signal processing.<br>- Continued development of a novel approach to near real time active digital augmentation to improve the isolation of shipboard EW systems.<br>- Continued progressing technology development in components and architectures for ES payloads.<br>- Continued progressing technology development in ES adaptive signal processing.<br>- Continued development of compact high power RF emulators.<br>- Continued technology development in the area of wideband distributed decoys and control.<br>- Continued technology development in the area of transmitters and EA techniques.<br>- Continued technology development in the areas of wideband critical receiver components and wideband adaptive RF signal processing.<br>- Completed 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.<br><br>Countermeasures and Techniques to Defeat Advanced RF Guided Threats:<br>- Continued investigation of MMW technologies to support the development of off board and onboard countermeasures.<br>- Continued technology development in the areas of wideband, high power, critical EA components, wideband EA techniques and technique generators, and millimeter wave high power transmitters.<br>- Continued research into determining the vulnerability of modern communications systems.<br>- Initiated development of a millimeter wave Rotman Lens-based electronic attack transmitter.<br>- Initiated development of a countermeasures technique using a new novel approach.<br><br>Countermeasures and Techniques to Defeat Advanced EO/IR Guided Threats:<br>- Continued 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.<br>- Continued efforts to Detect and Defeat Imaging IR sensors by developing laser-based countermeasures and advanced IR expendable decoys.<br>- Continued progressing the Directed Energy Defeat of Multi-Mode Threats effort by measuring missile seeker interference effects.<br>- Completed Multi-Wavelength Laser with Broad Spectrum Coverage effort by commencing quantum cascade (QC) and interband cascade (IC) chip design and fabrication in Band 4a.<br>- Completed High Power LWIR QC Lasers for Shipboard Infrared Countermeasures (IRCM) effort with device design and thermal modeling tasks. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Completed Layered Multi-band Obscurant effort by commencing numerical analysis to optimize the predicted performance of potential materials for macroparticle design and fabrication.<br><br>Modeling and Simulation:<br>- Continued technology development in the area of advanced architectures for modeling and simulation of networked EW assets.<br><br>Electronic Protection from EMI and EA:<br>- Continued 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.<br>- Continued 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.<br>- Initiated development of innovative high date-rate protected communications to circumvent malicious cyber-attack (Project Calliope)<br><br>Offboard/Unmanned Platforms - Electronic Warfare:<br>- Continued technology development in the area of autonomous control, high efficiency engines and EW payloads suitable for use in offboard and unmanned platforms.<br>- Continued development of low cost precision direction finding techniques for small UAVs.<br><br>Integrated Distributed Electronic Warfare System (IDEWS) concept:<br>- Completed technology development in the area of network-enabled, coordinated and spatially distributed EW.<br><br>Electronic Warfare (EW) Roadmap:<br>- Continued development of classified, advanced, electronic warfare technology in support of current and predicted capability requirements.<br><br>Wideband ES - Sensing/Processing:<br>- Continued technology development in the areas of wideband cueing receiver concepts.<br>- Continued development in critical receiver components that operate across the entire 1-110 GHz spectral range.<br>- Continued technology development in wideband adaptive RF signal processing methods and techniques.<br><br>Wideband EA - Components/Techniques:<br>- Continued technology development in high power critical EA system components that operate across the entire 1-110 GHz spectral range. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development in wideband EA techniques (waveforms) and techniques generators.<br>- Continued technology development in transmit-to-receive isolation technologies and techniques, relevant to the spectral range of 1 to 110 GHz.<br><br>Millimeter Wave (MMW) High Power Transmitters:<br>- Continued development in transmitter systems (consisting of power amplifier(s), matching network, and radiating element) capable of achieving 4-10 kW or greater ERP for small decoy applications or capable of being combined to achieve 100 kW or greater ERP for large platform applications across the entire 18-45 GHz frequency range.<br><br>Multispectral Semiconductor Lasers:<br>- Initiated development of semiconductor-based, multi-wavelength integrated laser sources spanning multiple bands of the ultraviolet, visible, near IR, mid-wave IR, and long-wave IR.<br><br>Continuously Tunable Multispectral Fiber/Waveguide Lasers:<br>- Initiated development of multi-wavelength integrated laser sources with optical fibers/waveguides as the lasing media.<br><br>Non-Mechanical Beam Steering:<br>- Initiated development of non-mechanical beam steering technologies to allow coherent energy to span multiple bands of the EO/IR spectrum. | | | |
| ***FY 2014 Plans:***<br>Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest:<br>- Continue all efforts of FY 2013.<br>- Complete development of multi-spectral imaging capability in Short Wave Infrared (SWIR), Mid-Wave Infrared (MWIR) and Long-Wave Infrared (LWIR) spectral bands using a rugged common aperture.<br>- Complete advancing in the understanding of cognitive/software defined radios used in communications.<br>- Complete development of algorithms/techniques to provide additional/improved maritime domain awareness from existing sensor data.<br><br>Components and Advanced Architectures/Signal Processing Designs:<br>- Continue all efforts of FY 2013.<br><br>Countermeasures and Techniques to Defeat Advanced RF Guided Threats:<br>- Continue all efforts of FY 2013. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Countermeasures and Techniques to Defeat Advanced EO/IR Guided Threats:<br>- Continue all efforts of FY 2013.<br><br>Modeling and Simulation:<br>- Continue all efforts of FY 2013.<br><br>Electronic Protection from EMI and EA:<br>- Continue all efforts of FY 2013.<br><br>Offboard/Unmanned Platforms - Electronic Warfare:<br>- Continue all efforts of FY 2013 less those noted as complete below.<br>- Complete development of low cost precision direction finding techniques for small UAVs.<br><br>Electronic Warfare (EW) Roadmap:<br>- Continue all efforts of FY 2013.<br><br>Wideband ES - Sensing/Processing:<br>- Continue all efforts of FY 2013.<br><br>Wideband EA - Components/Techniques:<br>- Continue all efforts of FY 2013.<br><br>Millimeter Wave (MMW) High Power Transmitters:<br>- Continue all efforts of FY 2013.<br><br>Multispectral Semiconductor Lasers:<br>- Continue all efforts of FY 2013 less those noted as completed above.<br><br>Continuously Tunable Multispectral Fiber/Waveguide Lasers:<br>- Continue all efforts of FY 2013 less those noted as completed above.<br><br>Non-Mechanical Beam Steering: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts of FY 2013 less those noted as completed above. | | | |
| ***FY 2015 Plans:***<br>Sensors for the Purpose of Detection, Localization, and Identification of Hostile Signals of Interest:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br>- Complete development of a process to determine direction of arrival based on multipath distortion of the received emission.<br>- Complete development of all-optical techniques for signal processing to provide multifunction RF capability.<br><br>Components and Advanced Architectures/Signal Processing Designs:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Countermeasures and Techniques to Defeat Advanced RF Guided Threats:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br>- Complete development of a millimeter wave Rotman Lens-based electronic attack transmitter.<br>- Complete development of a countermeasures technique using a new novel approach.<br>- Complete research into determining the vulnerability of modern communications systems.<br>- Initiate development of advanced technologies and techniques to counter emerging threats operating in higher bands of the radio frequency spectrum.<br>- Initiate development of advanced technologies and techniques to counter emerging threats utilizing extreme spectral and temporal agility.<br><br>Countermeasures and Techniques to Defeat Advanced EO/IR Guided Threats:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Modeling and Simulation:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Electronic Protection from EMI and EA:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Offboard/Unmanned Platforms - Electronic Warfare:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Electronic Warfare (EW) Roadmap: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts of FY 2014 less those noted as completed above.<br><br>Wideband ES - Sensing/Processing:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Wideband EA - Components/Techniques:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Millimeter Wave (MMW) High Power Transmitters:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Multispectral Semiconductor Lasers:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Continuously Tunable Multispectral Fiber/Waveguide Lasers:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Non-Mechanical Beam Steering:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Enabling Cognitive and Adaptive Electronic Warfare:<br>- Initiate technologies that develop new methods to represent real-time dynamic spectrum knowledge, sense and learn RF features and behaviors, and to reason about threat systems and the environment to form electronic attack strategies on-the-fly.<br><br>Technologies for High Throughput and Rapidly Programmable EW Systems:<br>- Initiate technologies that develop enabling technologies for reconfigurable EW systems that have extremely high-volume processing capability.<br><br>Emulation Environments for Adaptive and Targeted Electronic Warfare:<br>- Initiate technology development of emulated RF environments or modeling and simulation (M&S) environments to enable the development, testing, and validation of advanced cognitive and targeted EW techniques and systems. | | | |
| ***Title:*** EO/IR SENSOR TECHNOLOGIES | 5.609 | 4.871 | 5.606 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Description:*** The overarching objective of this thrust is to develop technologies that enable the development of affordable, wide area, persistent surveillance optical architectures, day/night/adverse 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:<br><br>a) Optically Based Terahertz (THz) and Millimeter Wave (MMW) Distributed Aperture Systems:<br>Develop optically based terahertz (THz) and millimeter wave distributed aperture systems for imaging through clouds, fog, haze and dust on air platforms.<br><br>b) Wide Area Optical Architectures: Develop wide area optical architectures for persistent surveillance for severely size constrained airborne applications.<br><br>c) Hyperspectral sensors and processing:<br>Develop visible, shortwave IR, mid-wave IR, and long-wave IR hyperspectral sensors, along with processing algorithms to detect anomalies and targets.<br><br>d) Coherent Laser Radar (LADAR):<br>Develop and improve components for LADAR applications including fiber lasers, coherent focal planes, and advanced processing.<br><br>e) Autonomous and Networked sensing:<br>Develop algorithms and processing that supports autonomous sensing for UAV platforms and that supports networked sensing over multiple sensors and/or sensor platforms.<br><br>Funding decrease from FY 2013 to FY 2014 is associated with realignment of funds and increased emphasis in Mission Focused Autonomy research in PE 0602235N.<br><br>The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.<br><br>***FY 2013 Accomplishments:***<br>Optically Based Terahertz (THz)and Millimeter Wave Distributed Aperture Systems: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued miniaturization and modularization of MMW imaging system components for small platform systems.<br>- Continued progressing the integration of spectrally agile multi-band sensors into integrated system for use in persistent and time critical surveillance.<br>- Continued progressing the processing architecture for data analysis and fusion of multi-spectral images.<br>- Continued and completed field demonstration and testing of 77 gigahertz (GHz) passive MMW imager. The 77 GHz band will be used in place of 94 GHz for decreased cost and risk.<br>- Initiated development of range-gated image reconstruction using optical phase conjugation.<br><br>Wide Area Optical Architectures:<br>- Continued development of mid and long wave IR focal plane arrays using graded-bandgap, Wtype-II, superlattices with much higher detectivity than state-of-the-art Mercury Cadmium Telluride (HgCdTe,MCT) FPAs.<br>- Continued design of read-out integrated circuits for temporally adaptive focal plane arrays.<br>- Continued development of spectrally agile visible, near-infrared, short-wave infrared and midwave infrared imaging technology.<br>- Continued development of super-resolution techniques in WFOV MWIR sensors.<br><br>Hyperspectral sensors and processing:<br>- Continued integration of hyperspectral instruments onto test platforms.<br>- Continued processing of hyperspectral data from a maritime environment.<br>- Initiated effort to develop mid-wave infrared focal plane arrays using plasmonically coupled antimonide based majority carrier barrier device structures on advanced digital readouts for ultra low size, weight, and power night-time wide area surveillance.<br><br>Coherent Laser Radar (LADAR):<br>- Continued development of fiber lasers and coherent focal plane arrays suitable for LADAR applications.<br>- Continued fabrication and modeling of silicon photonic chips for one dimensional beam steering.<br>- Initiated effort to develop fiber-based long wave infrared agile, narrow-band and broadband laser sources for sensing and counter measure applications.<br><br>Autonomous and Networked sensing:<br>- Continued development of algorithms and processing that supports autonomous sensing for UAV platforms<br>- Continued development of algorithms and processing that supports networked sensing over multiple sensors and/or sensor platforms. | | | |
| ***FY 2014 Plans:***<br>Optically Based Terahertz (THz)and Millimeter Wave Distributed Aperture Systems: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts of FY 2013 less those noted as completed above.<br><br>Wide Area Optical Architectures:<br>- Continue all efforts of FY 2013 less those noted as completed above.<br><br>Hyperspectral sensors and processing:<br>- Continue all efforts of FY 2013 less those noted as completed above.<br><br>Coherent Laser Radar (LADAR):<br>- Continue all efforts of FY 2013 less those noted as completed above.<br><br>Autonomous and Networked sensing:<br>- Continue all efforts of FY 2013 less those noted as completed above.<br>***FY 2015 Plans:***<br>Optically Based Terahertz (THz)and Millimeter Wave Distributed Aperture Systems:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Wide Area Optical Architectures:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Hyperspectral sensors and processing:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Coherent Laser Radar (LADAR):<br>- Continue all efforts of FY 2014 less those noted as completed above.<br>- Complete fabrication and modeling of silicon photonic chips for one dimensional beam steering.<br><br>Autonomous and Networked sensing:<br>- Continue all efforts of FY 2014 less those noted as completed above. | | | |
| ***Title:*** NAVIGATION TECHNOLOGY | 2.727 | 4.952 | 5.014 |
| ***Description:*** 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 GPS, non-GPS navigation devices, and atomic | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| 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:<br><br>a) GPS AJ Antennas and Receivers:<br>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.<br><br>b) Precision Time and Time Transfer Technology:<br>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.<br><br>c) Non-GPS Navigation Technology:<br>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.<br><br>Funding increase from FY 2013 to FY 2014 is the result of the increased emphasis and investment in Navigation Applied Research in this PE and comparable reduction in GPS Advanced Technology Development in PE 0603271N.<br><br>The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.<br><br>***FY 2013 Accomplishments:***<br>GPS Anti-Jam Antennas and Receivers:<br>- Continued Precise at-Sea Ship System for Indoor Outdoor Navigation (PASSION) project.<br>- Continued development of Military User Equipment Integrated Fault Analysis effort.<br>- Continued development of Modernized User Equipment (MUE) Integrated Fault Analysis Technology.<br>- Continued and completed Anti-tamper Investigation Support.<br>- Continued and completed System for enhanced electronic protection, electronic support and precision navigation.<br>- Completed Time-transfer via IEEE 1588 effort.<br>- Initiated and completed Automatic Dependant Surveillance-Mode B (ADS-B) National Airspace Air Traffic Control (ATC) System to Naval Aviation applications.<br>- Initiated Cognitive Modernized GPS User Equipment (MGUE) with Chaotic Timing Signals for GPS Denied Environments project. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Precision Time and Time Transfer Technology:<br>- Continued Evolved Global Navigation Satellite System (GNSS) Signal Monitoring Receiver Element project.<br>- Continued developing Advanced-Development of a Miniature Atomic Clock.<br>- Continued analysis of Code Distortion in Modernized GPS Signals on GPS Timing Receiver.<br>- Continued development of Compact and Versatile Passively CEP (carrier envelope phase) Stabilized Optical Clock system.<br>- Continued development of Micro Cold Atom Atomic Frequency Standard (CAAFS).<br>- Initiated Ultra-Precise Timing Using GPS project.<br><br>Non-GPS Navigation Technology:<br>- Continued Optically Transduced Inertial Navigation System (INS) Sensor Suite (OPTIMUSS) project.<br>- Continued 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.<br>- Continued development of Micro-Electro-Mechanical System (MEMS) Gyro effort.<br>- Continued development of Portable Precision Celestial Navigation System.<br>- Initiated research in Alternative Image-based Navigation. | | | |
| ***FY 2014 Plans:***<br>GPS Anti-Jam Antennas and Receivers:<br>- Continue all efforts of FY 2013 less those noted as completed above.<br>- Complete Modernized User Equipment (MUE) Integrated Fault Analysis Technology.<br>- Initate GPS Modernized Integrated Spoofer Tracking (MIST).<br><br>Precision Time and Time Transfer Technology:<br>- Continue all efforts of FY 2013.<br>- Complete development of Micro Cold Atom Atomic Frequency Standard (CAAFS).<br>- Complete Ultra-Precise Timing Using GPS project.<br><br>Non-GPS Navigation Technology:<br>- Continue all efforts of FY 2013.<br>- Initiate Embedded Sonar Aided Inertial Navigation Technology (SAINT) project.<br>- Initiate MEMS Inertial Navigation System Phase II project. | | | |
| ***FY 2015 Plans:***<br>GPS Anti-Jam Antennas and Receivers: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts of FY 2014 less those noted as completed above.<br>- Complete GPS Moderized Integrated Spoofer Tracking (MIST).<br><br>Precision Time and Time Transfer Technology:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br>- Initiate Robust Ultra-Precise Time Transfer Technology project.<br><br>Non-GPS Navigation Technology:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br>- Completed development of Portable Precision Celestial Navigation System.<br>- Completed Alternative Image-based Navigation project.<br>- Initiate Absolute Reference Grade Cold Atom Navigation project. | | | |
| ***Title:*** SOLID STATE ELECTRONICS | 8.687 | 10.486 | 9.645 |
| ***Description:*** The overarching objective of this activity is to develop higher performance components and subsystems for all classes of military 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, and smart weapon 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. 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). 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.<br><br>This activity also includes Anti-Tamper development of innovative techniques and technologies to deter the reverse engineering and exploitation of our military's critical technology and critical program information in order to impede technology transfer and alteration of system capability and prevent the development of countermeasures to U.S. systems. The current specific objectives are: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| a) Solid State Transistors and Devices: Develop solid state transistors and devices for high frequency analog and digital operation.<br><br>b) High Efficiency, Highly Linear Amplifiers: Develop high efficiency, highly linear amplifiers for microwave, millimeter-wave, low-noise, and power applications.<br><br>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, SATCOM, Electronic Warfare (EW), signal intelligence (SIGINT), and communications.<br><br>d) Control, Reception, Transmission, and Processing of Signals: Develop electronics and photonics technology that provides for the control, reception, transmission and processing of signals.<br><br>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 architectures to deliver ultra-low power, light weight and high performance computational capability for autonomous vehicles and individual warfighters.<br><br>f) Anti-Tamper: Develope innovative techniques and technologies to deter the reverse engineering and exploitation of our military's critical technology and critical program information in order to impede technology transfer and alteration of system capability and prevent the development of countermeasures to U.S. systems.<br><br>Funding increase from FY 2013 to FY 2014 is due to the progression of Anti-Tamper Technology research from Basic to Applied Research.<br><br>Funding decrease from FY 2014 to FY 2015 is the due to the completion of current packaging efforts and the reprioritizing of the additional work need to be pursued.<br><br>The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.<br><br>***FY 2013 Accomplishments:***<br>Solid State Transistors and Devices:<br>- Continued development of an integrated, tunable, frequency selective and low noise integrated module. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued effort to develop W-band high-power Gallium Nitride (GaN) Metal Insulator Semiconductor (MIS) transistors.<br>- Continued MMW field plate GaN High Electron Mobility Transistor (HEMT) development.<br>- Continued progressing mixed-signal GaN Monolithic Microwave Integrated Circuit (MMIC) technology development.<br>- Continued progressing on effort to develop on-wafer, integrated enhancement/depletion mode, GaN transistors for mixed-signal applications.<br>- Continued investigations into ultra-low noise, Group III-Nitride, transistor structures for RF and mm-wave receivers and transmitters.<br>- Continued group III-Nitride transistor development for 1 THz circuits.<br>- Continued effort to develop advanced graphene field-effect transistor (FET) technology for higher transistor cut-off frequency and lower power consumption in low-noise receivers.<br>- Initiated development of discrete, channelized, Gallium Nitride Transistors for linear and low noise transmit and receive amplifiers.<br>- Initiated development of high power density mm-wave transistor technology.<br>- Initiated effort to develop ultra-scaled AlN/GaN transistors to enable superior RF amplifier performance in G-band applications.<br><br>High Efficiency, Highly Linear Amplifiers:<br>- Continued development of MMW AlGaN/GaN wide bandgap HEMT.<br>- Continued development of AlGaN HEMT broadband amplifiers for electronic warfare decoys with increased power and efficiency than achieved with conventional solid state amplifiers.<br>- Continued high-efficiency microwave GaN HEMT amplifier development.<br>- Continued work on GaN MMW components at >44 GHz to allow for EHF SATCOM insertion and other MMW applications spanning to 95GHz.<br>- Continued expansion of scope of the GaN MMW device program.<br>- Continued component development in support of multifunctional electronic warfare.<br>- Continued transition of GaN high-efficiency microwave HEMT amplifiers to radar and communications applications.<br>- Continued development of MMW high efficiency amplifiers for satellite communications and compact high efficiency MMW sources for active denial systems.<br>- Continued development of high-efficiency broadband GaN HEMT amplifiers for electronic warfare applications.<br>- Continued Sub-MMW GaN Device technology for communications, target identification and high speed data processing.<br>- Continued development of GaN Monolithic Microwave Integrated Circuit (MMIC) Amplifier Technology for operation greater than (>)100 GHz.<br>- Continued development of high efficiency GaN amplifier MMICs for 50-100 GHz operation.<br>- Continued low-noise, high dynamic range Group-III Nitride amplifier development for W-band receivers.<br>- Initiated development of group III-Nitride amplifiers for terahertz amplification. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiated development of high power density, high output power, solid state mm-wave amplifiers.<br><br>Superconducting Electronics:<br>- Continued development of first packaged prototype of 1 cm squared HF-UHF antenna for space limited platforms such as UAVs.<br>- Continued development of effort to improve superconducting analog to digital converter performance by more than 2 bits as well as 2x in sample rate.<br>- Continued development of mixed superconducting/semiconducting output circuits that allow energy efficient data transfer to room temperature at >10 Gbps per line and precision amplification of signals returned to the superconducting domain. These technologies are critical to the delivery of maximum system functionality from superconducting electronics and enable transmitter interference mitigation in wideband receivers.<br>- Initiated research on components needed to achieve improved interference immunity.<br><br>Control, Reception, and Processing of Signals:<br>- Continued development of Gallium Nitride-based low-noise components for Interference Immune Navy Satcom receivers.<br>- Continued investigations into low-noise, high dynamic range group-III Nitride receiver components for W-band and higher signal detection.<br>- Initiated development of group III-Nitride terahertz receive technologies.<br>- Initiated work on multi-THz real-time signal processing using combination of high speed electronic, photonic, and metamaterial techniques.<br>- Initiated research into affordable digital array, interfacing technologies using low power, mixed signal approaches, wafer scale antennas, and analog photonic transmission techniques.<br>- Initiated research into compact, broadband filter and channelizer components targeting multi-octave operation in the range from VHF to W-band.<br>- Initiated effort to develop micro-miniature ferroelectrically active tunable acoustic wave devices for fast reconfiguration of circuits and systems operating at microwave through sub-millimeter-wave frequencies.<br><br>Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures:<br>- Continued developing new research in graphene synthesis and device concepts.<br>- Continued effort to develop the synthesis, fabrication and testing of grapheme-based electromechanical structures and devices.<br>- Continued effort to develop the synthesis, fabrication and testing of grapheme-based electromechanical structures and devices.<br>- Continued work on graphene based devices and circuits for low power flexible electronics.<br>- Continued research on graphene-organic hybrid materials interfaces and device structures. | | | |
| ***FY 2014 Plans:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Solid State Transistors and Devices:<br>- Continue all efforts of FY 2013.<br>- Complete effort to develop on-wafer integrated enhancement/depletion mode GaN transistors for mixed-signal applications.<br>- Initiate effort to develop and exploit reduced dimensionality transistors.<br><br>High Efficiency, Highly Linear Amplifiers:<br>- Continue all efforts of FY 2013.<br>- Initiate effort to develop transmit and receive components using reduced dimensionality transistors.<br><br>Superconducting Electronics:<br>- Continue all efforts of FY 2013.<br>- Initiate effort to develop reprogrammable superconducting digital filters capable of limiting Instantaneous Bandwidth (IBW) of output data stream from Analog-to-Digital Converter (ADC) to user defined choices and doing this with >10X lower processing latency and energy cost than possible in room temperature circuits.<br>- Initiate effort to design of Analog-to-Digital Converters (ADC) to enhance minimum detectable signal sensitivity levels by 10 dB.<br><br>Control, Reception, Transmission, and Processing of Signals:<br>- Continue all efforts of FY 2013.<br>- Initiate efforts to develop compact, high performance switch, filter, and high isolation device technologies for agile, broadband signal processing in cluttered environments.<br><br>Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures:<br>- Complete effort to develop the synthesis, fabrication and testing of grapheme-based electromechanical structures and devices.<br><br>Anti-Tamper:<br>- Initiate efforts to develop physically unclonable functions and high density 3D packaging technologies.<br>- Initiate efforts to develop destruct mechanisms that do not cause collateral damage.<br>- Initiate efforts to develop advanced sensors and coatings. | | | |
| ***FY 2015 Plans:***<br>Solid State Transistors and Devices:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br>- Complete effort to develop advanced graphene field-effect transistor (FET) technology for higher transistor cut-off frequency and lower power consumption in low-noise receivers. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate heterogeneous 2D transistor development.<br><br>High Efficiency, Highly Linear Amplifiers:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br><br>Superconducting Electronics:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br>- Completed development of first packaged prototype of 1 cm squared HF-UHF antenna for space limited platforms such as UAVs.<br>- Completed development of mixed superconducting/semiconducting output circuits that allow energy efficient data transfer to room temperature at >10 Gbps per line and precision amplification of signals returned to the superconducting domain. These technologies are critical to the delivery of maximum system functionality from superconducting electronics and enable transmitter interference mitigation in wideband receivers.<br>- Initiate heterogeneous component technology development to enable performance enhancement of analog-digital converters and ultra-wideband receivers and transmitters.<br><br>Control, Reception, Transmission, and Processing of Signals:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br>- Initiate RF electronics and photonics development to implement wideband Simultaneous Transmit and Receive sensing and communications apertures on disadvantaged platforms.<br><br>Novel Nanometer Scale Logic/Memory Devices and Related Circuits and Architectures:<br>- Continue all efforts of FY 2014 less those noted as completed above.<br>- Initiate large-scale hexagonal boron nitride (hBN) synthesis as substrate for graphene and other 2D materials.<br><br>Anti-Tamper:<br>- Continue all efforts of FY 2014 less those noted as completed above. | | | |
| ***Title:*** SURVEILLANCE TECHNOLOGY | 8.984 | 9.539 | 10.915 |
| ***Description:*** 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. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

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.

d) Small UAV Collision Avoidance/Autonomy Technology: Develop small UAV collision avoidance/autonomy technology.

e) Long Range Radio Frequency (RF) Identification (ID): Develop, hardware, software, algorithms, and RF techniques to extend identification capabilities in support of Intelligence Surveillance and Reconnaissance (ISR).

The increase from FY 2014 to FY 2015 is due to funds being moved from 6.1 to 6.2 to address maturation with experimentation of network sensing of multiple threats with advanced jamming.

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

***FY 2013 Accomplishments:***

Radar Architectures, Sensors, and Software which Address Ballistic Missile and Littoral Requirement Shortfalls:
- Continued Advanced Common Radar Architecture and mode development.
- Completed 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:

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued demonstrations of advanced Non-Cooperative Target Recognition (NCTR) algorithms in congested harbor environments.<br>- Continued development of a process to detect hostile camouflaged or hidden targets in shadows and diverse backgrounds of militarily challenged environments.<br>- Continued investigation of means of optimally combining mensuration, classification, and noncooperative target recognition of surface craft.<br>- Continued development of a technology architecture for the Persistent Autonomous Surveillance System.<br>- Continued development of automated controls for an airborne persistent multi-node sensor network.<br>- Continued progressing development of algorithms and signal processing for Electronic Protection in airborne radars.<br>- Continued progressing development of software and algorithms for multi-platform radar controls.<br>- Initiated development of a technique to measure motion with a multi- aperture synthetic aperture radar.<br>- Initiated development of amplitude control of radar transmit waveforms.<br>- Initiated development of design and full-wave characterization of phased-array systems using the domain decomposition-finite element method.<br><br>Software and Hardware for a Multi-Platform, Multi-Sensor Surveillance System:<br>- Continued development of signal processing techniques to improve situational awareness and autonomous detection of hostile fire events in a dynamic urban clutter environment.<br>- Continued progressing the development of technologies for a distributed, coherent surveillance network embedded in the background electromagnetic environment of a broadband wireless communication network.<br><br>Small UAV Collision Avoidance/Autonomy Technology:<br>- Continued development of research technologies and analytical algorithms for an effective and highly reliable collision avoidance system.<br><br>Long Range Radio Frequency (RF) Identification (ID):<br>- Continue studies for Long Range RFID techniques and initial hardware designees.<br>***FY 2014 Plans:***<br>Radar Architectures, Sensors, and Software which Address Ballistic Missile and Littoral Requirement Shortfalls:<br>- Continue all efforts of FY 2013 less those noted as complete above.<br><br>Algorithms, Sensor Hardware, and Signal Processing Techniques for Automated Radar Based Contact Mensuration And Feature Extraction: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts of FY 2013 less those noted as complete above.<br><br>Software and Hardware for a Multi-Platform, Multi-Sensor Surveillance System:<br>- Continue all efforts of FY 2013 less those noted as complete above.<br>- Complete development of technologies for a distributed, coherent surveillance network embedded in the background electromagnetic environment of a broadband wireless communication network.<br><br>Small UAV Collision Avoidance/Autonomy Technology:<br>- Continue all efforts of FY 2013 less those noted as complete above.<br><br>Long Range Radio Frequency (RF) Identification (ID):<br>- Continue all efforts of FY 2013 less those noted as complete above.<br>***FY 2015 Plans:***<br>Radar Architectures, Sensors, and Software which Address Ballistic Missile and Littoral Requirement Shortfalls:<br>- Continue all efforts of FY 2014 less those noted as complete above<br>- Initiate High Power, High Duty Factor, X-band Amplifier<br><br>Algorithms, Sensor Hardware, and Signal Processing Techniques for Automated Radar Based Contact Mensuration And Feature Extraction:<br>- Continue all efforts of FY 2014 less those noted as complete above<br><br>Software and Hardware for a Multi-Platform, Multi-Sensor Surveillance System:<br>- Continue all efforts of FY 2014 less those noted as complete above.<br>- Complete development of technologies for a distributed, coherent surveillance network embedded in the background electromagnetic environment of a broadband wireless communication network.<br>- Completed distributed network research on waveforms funded in prior year via 0601153N.<br>- Initiate modeling and simulation of shipboard and airborne RF networked sensors to characterize their performance in a challenge environment.<br>- Initiate field measurement to characterize coherent and non-coherent position, navigation, timing and communications requirements.<br><br>Long Range Radio Frequency (RF) Identification (ID): | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts of FY 2014 less those noted as complete above. | | | |
| ***Title:*** VACUUM ELECTRONICS POWER AMPLIFIERS | 2.768 | 3.168 | 3.357 |

***Description:*** 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 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.

***FY 2013 Accomplishments:***
High Power Millimeter and Upper Millimeter Wave Amplifiers:
- Continued developing non-linear multi-frequency stability analysis of wide-band traveling wave tub amplifiers in order to extend millimeterwave output power limits to >2 kilowatts.
- Continued effort to develop a Density Modulated Electron Source.
- Continued electromagnetic modeling and cold testing of beam-wave interaction structures for W-band amplifiers having octave bandwidth.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Lithographic Fabrication Techniques:<br>- Continued effort to develop 220 GHz millimeter-wave amplifiers employing electromagnetic structures that are microfabricated using lithographic techniques.<br>- Initiated effort to produce a high-power (>100 W) millimeter-wave vacuum electronic amplifier at G-band using microfabrication techniques developed at NRL in conjunction with a new type of high-gain interaction circuit.<br><br>Accurate and Computationally Effective Device-Specific Multi-Dimensional Models for Electron Beams:<br>- Initiated effort to develop a cascaded multiple-beam traveling wave amplifier, which is expected to provide unprecedented linear output power at millimeter wave frequencies (~30-40 GHz).<br>***FY 2014 Plans:***<br>High Power Millimeter and Upper Millimeter Wave Amplifiers:<br>- Continue all efforts of FY 2013 less those noted as complete above.<br>- Complete developing non-linear multi-frequency stability analysis of wide-band traveling wave tub amplifiers in order to extend millimeterwave output power limits to >2 kilowatts.<br><br>Lithographic Fabrication Techniques:<br>- Continue all efforts of FY 2013 less those noted as complete above.<br>***FY 2015 Plans:***<br>High Power Millimeter and Upper Millimeter Wave Amplifiers:<br>- Continue all efforts of FY 2014 less those noted as complete above.<br>- Complete effort to develop a Density Modulated Electron Source.<br>- Complete electromagnetic modeling and cold testing of beam-wave interaction structures for W-band amplifiers having octave bandwidth.<br><br>Lithographic Fabrication Techniques:<br>- Continue all efforts of FY 2014 less those noted as complete above. | | | |
| ***Title:*** NETTED EMULATION OF MULTI-ELEMENT SIGNATURES AGAINST INTEGRATED SENSORS (NEMESIS) INNOVATIVE NAVAL PROTOTYPE (INP) | - | 17.238 | 9.150 |
| ***Description:*** The objective is to develop a System of Systems (SoS) able to coordinate distribute EW resources against many adversary surveillance and targeting sensors simultaneously. It will benefit the warfighter by providing platform protection across | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| the battlespace against many sensors, creating seamless cross-domain countermeasure coordination, and enabling rapid advanced technology/capability insertion to counter emerging threats.<br><br>a) Develop reconfigurable and modular EW payloads, Distributed Decoy and Jammer Swarms (DDJS), effective multi-spectral countermeasures (CM), and Multiple Input/Multiple Output Sensor/CM (MIMO S/CM) for platform protection across operational domains.<br><br>Increase in FY 2014 is due to the transfer of funding from PE 0602114N and increased investment supporting NEMESIS development of EW payloads and platform integration. NEMESIS related EW payloads research was initiated in PE 0602114N in FY 2013.<br><br>Funding decrease from FY2014 to FY2015 is due to the expansion of the program and the requirements and associated funding being executed from 0603271N.<br><br>***FY 2013 Accomplishments:***<br>N/A<br>***FY 2014 Plans:***<br>- Initiate development of the NEMESIS EW payloads and their integration into platforms.<br>- Initiate research supporting distributed control, coordination and networking of NEMESIS payloads and platforms.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014 less those noted as complete above. | | | |
| **Accomplishments/Planned Programs Subtotals** | 73.985 | 97.690 | 107.872 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

This PE supports the development of technologies that address 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

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602271N / *Electromagnetic Systems Applied Research* | **Project (Number/Name)**<br>0000 / *Electromagnetic Systems Applied Research* |

to enable capabilities in Missile Defense, Directed Energy, Platform Protection, Time Critical Strike, and Information Distribution. 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 a secure, over the horizon, on-the- move capability to communicate with higher headquarters at a data rate of 256-512 Kbps at a cost of $75,000.
- Provide an array configuration suitable for installation on aircraft that will support TCDL data rates of 10.7 and 45 Mbps at greater than 150 nautical mile range.
- Develop prototype Ku band phased array apertures in a form factor suitable for installation on the CVN-78.

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | | Date: March 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | | | | | R-1 Program Element (Number/Name)<br>PE 0602435N *I Ocean Wrfghtg Env Applied Res* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 54.912 | 45.685 | 45.388 | - | 45.388 | 43.941 | 45.963 | 46.790 | 46.918 | Continuing | Continuing |
| 0000: *Ocean Wrfghtg Env Applied Res* | 0.000 | 41.162 | 45.685 | 45.388 | - | 45.388 | 43.941 | 45.963 | 46.790 | 46.918 | Continuing | Continuing |
| 9999: *Congressional Adds* | 0.000 | 13.750 | - | - | - | - | - | - | - | - | - | 13.750 |

# The FY 2015 OCO Request will be submitted at a later date.

**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 (Sep 2011). 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, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | **R-1 Program Element (Number/Name)**<br>PE 0602435N *I Ocean Wrfghtg Env Applied Res* |

| B. Program Change Summary ($ in Millions) | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 49.635 | 45.685 | 46.279 | - | 46.279 |
| Current President's Budget | 54.912 | 45.685 | 45.388 | - | 45.388 |
| Total Adjustments | 5.277 | - | -0.891 | - | -0.891 |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | -2.794 | - | | | |
| • SBIR/STTR Transfer | -1.537 | - | | | |
| • Program Adjustments | - | - | -0.891 | - | -0.891 |
| • Rate/Misc Adjustments | 0.001 | - | - | - | - |
| • Congressional General Reductions Adjustments | -5.393 | - | - | - | - |
| • Congressional Add Adjustments | 15.000 | - | - | - | - |

| Congressional Add Details ($ in Millions, and Includes General Reductions) | FY 2013 | FY 2014 |
|---|---|---|
| **Project:** 9999: *Congressional Adds* | | |
| Congressional Add: *AGOR Mid-life Refit* | 13.750 | - |
| Congressional Add Subtotals for Project: 9999 | 13.750 | - |
| Congressional Add Totals for all Projects | 13.750 | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 2 | R-1 Program Element (Number/Name)<br>PE 0602435N / *Ocean Wrfghtg Env Applied Res* | Project (Number/Name)<br>0000 / *Ocean Wrfghtg Env Applied Res* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000: *Ocean Wrfghtg Env Applied Res* | - | 41.162 | 45.685 | 45.388 | - | 45.388 | 43.941 | 45.963 | 46.790 | 46.918 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** Coastal Geosciences/Optics | 6.557 | 7.701 | 6.627 |
| ***Description:*** 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 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.<br><br>Funding increase from FY 2013 to FY 2014 due to programs assigned to NRL-Base. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602435N / *Ocean Wrfghtg Env Applied Res* | **Project (Number/Name)**<br>0000 / *Ocean Wrfghtg Env Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

The funding decrease from FY 2014-FY 2015 in R2 Activity Coastal Geosciences/Optics is due to the completion of the development of a next generation atmospheric correction algorithm, the completion of the development of new data storage topologies and ensemble methods for irregular, multi-resolution, geophysical data, and the effort to quantify the effect that different sensor viewing angles and gain factors have on optical data measurements.

***FY 2013 Accomplishments:***

- 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 effort to understand and predict how power harvesting from the seabed is controlled by sediment geochemistry, microbiology, properties, and energetics.
- Continued 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.
- Continued effort to develop an intelligent decluttering algorithm (or system of algorithms) that accounts for both global and local clutter metrics in complex, multivariate displays.
- Continued 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.
- Continued development of riverine expert system for environmental characterization.
- Continued an effort to create a unified framework for measuring, recording, aggregating and presenting the uncertainty of data, models, and processes to support current and future efforts to add certainty measures to environmental products.
- Continued development of new data storage topologies and ensemble methods for irregular, multi-resolution, geophysical data.
- Continued the effort to detect and recognize targets beneath foliage using new polarimetric analysis techniques applied to ultra wideband(UWB) synthetic aperture radar (SAR) imagery.
- Continued the effort to quantify the effect that different sensor viewing angles and gain factors have on optical data measurements, to determine how these differences relate to natural variability, and to establish temporal and spatial coherence scales in support of blending data products from multiple sensors.
- Completed an effort to create a unified framework for measuring, recording, aggregating and presenting the uncertainty of data, models, and processes to support current and future efforts to add certainty measures to environmental products.
- Initiated studies for rapidly relocatable prediction models for riverine, estuarine and nearshore environments.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602435N / *Ocean Wrfghtg Env Applied Res* | **Project (Number/Name)**<br>0000 / *Ocean Wrfghtg Env Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiated the development of methods to retrieve water depth, bottom type and water constituents in complex coastal waters, inland waterways, and denied areas using multispectral imagery (MSI) by extending techniques used for coarser resolution hyperspectral imagery to account for larger (MSI) data sets.<br>- Initiated the development of a new capability for the Navy to forecast the temporal and spatial evolution of bottom roughness along sandy coasts by developing a seafloor boundary layer model to predict spectral description of seafloor and sediment transport and then two-way coupling it to an ocean wave model.<br>- Initiated development of the BMFC (Benthic Microbial Fuel Cell) into a functionally capable technology practical for powering Navy devices.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013 less those noted as completed above.<br>- Complete effort to develop a next generation atmospheric correction algorithm which will geratly enhance ocean passive retrievals including ocean color and visibility, bathymetry and saa surface temperature.<br>- Complete development of new data storage topologies and ensemble methods for irregular, multi-resolution, geophysical data.<br>- Complete the effort to quantify the effect that different sensor viewing angles and gain factors have on optical data measurements, to determine how these differences relate to natural variability, and to establish temporal and spatial coherence scales in support of blending data products from multiple sensors.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014 less those noted as completed above.<br>- Complete the development of methods to retrieve water depth, bottom type and water constituents in complex coastal waters, inland waterways, and denied areas using multispectral imagery (MSI) by extending techniques used for coarser resolution hyperspectral imagery to account for larger (MSI) data sets.<br>- Complete the development of a new capability for the Navy to forecast the temporal and spatial evolution of bottom roughness along sandy coasts by developing a seafloor boundary layer model to predict spectral description of seafloor and sediment transport and then two-way coupling it to an ocean wave model.<br>- Complete the effort to detect and recognize targets beneath foliage using new polarimetric analysis techniques applied to ultra wideband (UWB) synthetic aperture radar (SAR) imagery. | | | |
| ***Title:*** Marine Mammals and Biology<br>***Description:*** 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 | 4.059 | 4.771 | 3.653 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602435N / *Ocean Wrfghtg Env Applied Res* | **Project (Number/Name)**<br>0000 / *Ocean Wrfghtg Env Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

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 PE represents part of a total effort executed in coordination with complementary research performed in PE 0602747N. The emphasis of efforts within PE 0602435N are Marine Mammals and Biology thrusts that include Integrated Ecosystem Research/Sensor and Tag Development, Controlled Exposure Experiments (captive, free-ranging European waters), part of the Monitoring & Detection thrust (DCL algorithm development), and effects of chronic stress (free-ranging animal studies).

Funding decreases from FY2014 to FY2015 due to completion of studies to examine sensitivity of fish to anthropogenic sound and completion of bioluminescence studies.

***FY 2013 Accomplishments:***
- Continued at-sea demonstration of radar and acoustics systems to monitor marine mammals in fleet activities.
- Continued multi-investigator, coordinated field research to test responses of marine mammals (especially beaked whales) to controlled sound exposures.
- Continued 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.
- Continued research examining hearing sensitivity of marine mammals (including temporary and permanent threshold shifts).
- Continued research efforts examining distributions and abundances of marine mammals relative to prey fields and basic oceanographic parameters.
- Continued development of and evaluated models that predict time- and space-dependent sound fields produced by anthropogenic noise sources and mammal responses to the noise.
- Continued development and testing of multi-frequency acoustic technologies for detection, identification and enumeration of fish.
- Continued research to examine sensitivity of fish to anthropogenic sound.
- Continued research leading to better predictability of bioluminescent and pigment-bearing planktonic organisms.
- Continued research on the physiology and stress of marine mammals in the wild.

***FY 2014 Plans:***
- Continue all efforts of FY 2013 unless completed above.
- Complete research to examine sensitivity of fish to anthropogenic sound.
- Complete research leading to better predictability of bioluminescent and pigment-bearing planktonic organisms.

***FY 2015 Plans:***

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602435N / *Ocean Wrfghtg Env Applied Res* | **Project (Number/Name)**<br>0000 / *Ocean Wrfghtg Env Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts of FY 2014 less those noted as completed above. | | | |
| ***Title:*** Marine Meteorology | 8.270 | 11.311 | 12.120 |

***Description:*** 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.

Funding increase from FY 2013 to FY 2014 reflects increased emphasis across Marine Meteorology efforts including ramp up of some efforts initiated in FY 2012.

Funding increase from FY 2014 to FY 2015 due to increased research towards developing a predictive capability for the impact of clouds, aerosols, and moisture gradients in littoral areas on electromagnetic and electro-optic propagation in support of new Naval sensors and weapons as part of Electromagnetic Maneuver Warfare. Also, to increase capability to assimilate non-traditional data sources such as those from autonomous systems and remote sensing for prediction of conditions in denied and degraded areas. Also an improved application for probabilistic prediction of air and sea conditions for ship routing and operational planning that enables increased energy efficiency and operational effectiveness.

***FY 2013 Accomplishments:***
- Continued the design, assembly, testing and delivery of a threat detection technology for Tier 1 environmental analysis of aerosols.
- Continued development of a capability to accurately map the vertical distribution of clouds and cloud properties through the utilization and fusion of multiple satellite remote sensing data sets in synergy with improved numerical weather prediction (NWP) modeled cloud fields.
- Continued development and testing of a space-based, land surface assimilation system that utilizes satellite observations and mature atmospheric data assimilation systems, to be incorporated into the Navy's operational numerical weather prediction (NWP) systems.
- Completed development, testing and validation of next-generation TC prediction system that can analyze, initialize, and predict TC track, structure and intensity, using a high-resolution mesoscale model coupled to the ocean waves and currents. The

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602435N / *Ocean Wrfghtg Env Applied Res* | **Project (Number/Name)**<br>0000 / *Ocean Wrfghtg Env Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| development included advanced data assimilation and moveling techniques as well as new methods of retrieving observations from remote sensing.<br>- Completed an effort to develop an explicit, interactive cloud-radiation modeling approach to simulate primary cloud dynamics for NWP, and lay the foundation for interactive studies of greenhouse gases and anthropogenic and natural aerosols that have been proven to be critical for climate change.<br>- Initiated the development of the ability to accurately detect, monitor and forecast the 3-D areal extent of global airborne dust, volcanic ash, and smoke and improve aerosol optical depth analyses and forecasts through the use of a suite of satellite sensors and the Navy Atmospheric Aerosol Prediction System (NAAPS).<br>- Initiated the development of a Hybrid Ensemble 4D-VAR Data Assimilation (DA) scheme for regional models based on the global data assimilation techniques, in order to simultaneously estimate regional and global model initial conditions.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013 less those noted as completed above.<br>- Complete development of a capability to accurately map the vertical distribution of clouds and cloud properties through the utilization and fusion of multiple satellite remote sensing data sets in synergy with improved numerical weather prediction (NWP) modeled cloud fields.<br>- Complete development and testing of a space-based, land surface assimilation system that utilizes satellite observations and mature atmospheric data assimilation systems, to be incorporated into the Navy's operational numerical weather prediction (NWP) systems.<br>- Complete the 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.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014 less those noted as completed above.<br>- Complete the design, assembly, testing and delivery of a threat detection technology for Tier 1 environmental analysis of aerosols.<br>- Complete the development of the ability to accurately detect, monitor and forecast the 3-D areal extent of global airborne dust, volcanic ash, and smoke and improve aerosol optical depth analyses and forecasts through the use of a suite of satellite sensors and the Navy Atmospheric Aerosol Prediction System (NAAPS).<br>- Complete the development of a Hybrid Ensemble 4D-VAR Data Assimilation (DA) scheme for regional models based on the global data assimilation techniques, in order to simultaneously estimate regional and global model initial conditions.<br>- Complete the design, assembly, testing and delivery of a threat detection technology for Tier 1 environmental analysis of aerosols. | | | |
| ***Title:*** National Oceanographic Partnership Program (NOPP) | 7.449 | 8.749 | 8.820 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602435N / *Ocean Wrfghtg Env Applied Res* | **Project (Number/Name)**<br>0000 / *Ocean Wrfghtg Env Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

***Description:*** 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.

Funding increase from FY 2013 to FY 2014 due to the initiation for the Arctic Remote Sensing program and the Advancing Air/ Ocean/Land/ Ice global Coupled Prediction on Emerging Computational Architectures program.

Funding increase from FY 2014 to FY 2015 due to an effort to develop a significantly improved capability to simulate and predict the coupled global air-ocean-wave-land-sea ice system at eddy-resolving spatial scales in a computationally efficient, massively parallel architecture towards real-time operational environmental prediction. Focus is on mathematical reformulation and computational software re-engineering of geophysical fluid dynamical systems to gain better scalability without loss of accuracy on heterogeneous petaflop architectures.

***FY 2013 Accomplishments:***
- 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 real-time forecasting system of winds, waves and surge in TCs.
- Continued effort to develop global ocean models with sufficient resolution to accurately simulate tides and internal waves to improve the fidelity of ocean prediction systems.
- Continued development of improving wind-wave predictions: global to regional scales.
- Completed marine mammal program on noise mitigation.
- Completed development of sensors for sustained, autonomous measurement of chemical or biological parameters in the ocean.
- Completed marine mammal program on methods for detection and tracking of marine mammals and mapping their habitat.
- Completed real-time forecasting system of winds, waves and surge in TCs.
- Initiated study of arctic processes.
- Initiated development of global and climate prediction studies.

***FY 2014 Plans:***
- Continue all efforts of FY 2013 less those noted as completed above.
- Initiate an Arctic remote sensing program.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602435N / *Ocean Wrfghtg Env Applied Res* | **Project (Number/Name)**<br>0000 / *Ocean Wrfghtg Env Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate an Advancing Air/Ocean/Land/Ice Global Coupled Prediction on Emerging Computational Architectures program.<br><br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014 less those noted as completed above.<br>- Complete a study on Improving Wind Wave Predictions: Global to Regional Scales.<br>- Complete a project to develop an high resolution version of HYCOM with tides. | | | |
| ***Title:*** Ocean Acoustics | 5.663 | 4.290 | 3.508 |
| ***Description:*** 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.<br><br>Funding decrease from FY 2013 to FY 2014 is due to the completion of efforts associated with acoustic noise shielding and acoustic propagation models.<br><br>***FY 2013 Accomplishments:***<br>- Continued development of an integrated hydrodynamic/acoustic propagation modeling capability for littoral regions to predict acoustic ASW system performance in dynamic environments.<br>- Continued development of a TDA that can predict the dynamic oceanographic characteristics of shallow-water internal waves and their effects on underwater acoustic signals.<br>- Continued development of a validated, physics-based processing algorithm that diagnoses acoustic performance directly from oceanographic data.<br>- 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.<br>- 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. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602435N / *Ocean Wrfghtg Env Applied Res* | **Project (Number/Name)**<br>0000 / *Ocean Wrfghtg Env Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of an ocean magnetic prediction system for magnetic fields generated by high amplitude internal waves, internal bores, and internal solitary waves.<br>- Continued effort to exploit acoustic noise shielding effects of complex geologic structures on ocean basin margins to enhance performance of buried passive acoustic sensors.<br>- Continued effort to improve representation of ocean uncertainty in acoustic propagation models using a multiscale ocean data assimilation algorithm.<br>- Initiated development of a coupled algorithm to assimilate in-situ acoustic data into an acoustic model used for autonomous system decision support.<br>- Initiated enhancements to the accuracy of acoustic performance predictions through stochastic algorithms dealing with environmental uncertainty.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013 unless completed above.<br>- Complete effort to exploit acoustic noise shielding effects of complex geologic structures on ocean basin margins to enhance performance of buried passive acoustic sensors.<br>- Complete effort to improve representation of ocean uncertainty in acoustic propagation models using a multiscale ocean data assimilation algorithm.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014 unless completed above.<br>- Complete enhancements to the accuracy of acoustic performance predictions through stochastic algorithms dealing with environmental uncertainty. | | | |
| ***Title:*** Physical Oceanography | 9.164 | 8.863 | 10.660 |
| ***Description:*** 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 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.<br><br>Funding increase from FY 2014 to FY 2015 due to the implementation and integration of coastal forecast models into the TOPSIDE command and control and mission planning system. These models will have a data assimilation to utilize the data | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602435N / *Ocean Wrfghtg Env Applied Res* | **Project (Number/Name)**<br>0000 / *Ocean Wrfghtg Env Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

sets featured in the data fusion section of the software. The system is of interest to Naval Special Warfare and to Naval Oceanographic Office for their Glider Operations Center.

***FY 2013 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.
- Continued new ocean mixed-layer algorithms for generation of synthetic profiles which has led to the operational implementation of a new 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 airsea interface in coupled ocean-atmosphere models, to improve operational predictions of the BSE.
- 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 the development of synthetic aperture radar (SAR) 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 development of predictive capability of internal wave affects on the battlespace, including affects on acoustic transmission.
- Continued the development of the coupled Delft3-D-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.
- Continued on-board processing of METOC data on gliders/UUV for exfiltration consistent with operational concept of operations.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602435N / *Ocean Wrfghtg Env Applied Res* | **Project (Number/Name)**<br>0000 / *Ocean Wrfghtg Env Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued the custom installation of adaptive sampling algorithms for minimizing acoustic uncertainty using persistent, reconfigurable sampling by UUVs using Naval Oceanographic (NAVO) modeling systems.<br>- Continued an effort to utilize data from new mooring technologies in combination with AUV data to develop practical methodologies to identify and extract the AUV-data spectral content that is not accurately represented in operational systems currently assimilating these data.<br>- Continued an effort to quantitatively determine how the optical properties of the upper ocean's organic constituents modify physical processes, such as the depth penetration of shortwave radiation into the ocean, and integrate a representation of bio-optical variability into the coupled ocean/atmosphere modeling framework.<br>- Continued the development of ensemble methods to explore the propagation of uncertainty through the ocean-atmosphere coupled system and into the ocean state.<br>- Completed an effort to utilize data from new mooring technologies in combination with AUV data to develop practical methodologies to identify and extract the AUV-data spectral content that is not accurately represented in operational systems currently assimilating these data.<br>- Completed an effort to quantitatively determine how the optical properties of the upper ocean's organic constituents modify physical processes, such as the depth penetration of shortwave radiation into the ocean, and integrate a representation of bio-optical variability into the coupled ocean/atmosphere modeling framework.<br>- Initiated the development of the Navy's first high-resolution fully coupled relocatable ice-ocean-atmosphere (IOA) prediction system by building coupling software to couple the CICE ice model into the COAMPS system, evaluating the results and then demonstrating the capability.<br>- Initiated the effort to extend the predictability of currents, waves and density structure in the coastal ocean by building a coupled 4D-VAR data assimilation capability for coupled ocean-wave models and use this ability to define prediction sensitivity to targeted observations. | | | |
| ***FY 2014 Plans:***<br>- Continue all efforts of FY 2013 less those noted as completed above.<br>- Complete the development of ensemble methods to explore the propagation of uncertainty through the ocean-atmosphere coupled system and into the ocean state. | | | |
| ***FY 2015 Plans:***<br>- Continue all efforts of FY 2014 less those noted as completed above.<br>- Complete the development of the Navy's first high-resolution fully coupled relocatable ice-ocean-atmosphere (IOA) prediction system by building coupling software to couple the CICE ice model into the COAMPS system, evaluating the results and then demonstrating the capability. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602435N / *Ocean Wrfghtg Env Applied Res* | **Project (Number/Name)**<br>0000 / *Ocean Wrfghtg Env Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete the effort to extend the predictability of currents, waves and density structure in the coastal ocean by building a coupled 4D-VAR data assimilation capability for coupled ocean-wave models and use this ability to define prediction sensitivity to targeted observations. | | | |
| **Accomplishments/Planned Programs Subtotals** | 41.162 | 45.685 | 45.388 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**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-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 2 | R-1 Program Element (Number/Name)<br>PE 0602435N / *Ocean Wrfghtg Env Applied Res* | Project (Number/Name)<br>9999 / *Congressional Adds* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9999: *Congressional Adds* | - | 13.750 | - | - | - | - | - | - | - | - | - | 13.750 |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

Congressional Interest Items not included in other Projects.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 |
|---|---|---|
| ***Congressional Add:*** AGOR Mid-life Refit | 13.750 | - |
| ***FY 2013 Accomplishments:*** FY13 funding will support the overhaul, re-fit and upgrade of Navy research vessel THOMAS G THOMPSON (AGOR 23). In FY13 funds will be awarded to the University of Washington to initiate a six-month detailed engineering design effort by a naval architect, followed by a competitive selection for a shipyard to implement the design plans. The THOMPSON will enter the shipyard in November 2014 to begin the refit.<br><br>Deliverables will support new environmental compliance requirements regarding ballast water treatment, marine sanitation, engine exhaust, incinerator exhaust, air conditioning refrigerants, and oily-water separation. Additional deliverables will overcome obsolescence of diesel engine and electrical system components, and enhance the ship safety with piping replacements in the ship's firemain and ballast water systems. | | |
| ***FY 2014 Plans:*** N/A | | |
| **Congressional Adds Subtotals** | 13.750 | - |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

Not applicable.

**E. Performance Metrics**

Congressional Interest Items not included in other Projects.

THIS PAGE INTENTIONALLY LEFT BLANK

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | | | | | R-1 Program Element (Number/Name)<br>PE 0602651M *I JT Non-Lethal Wpns Applied Res* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 5.234 | 6.059 | 5.887 | - | 5.887 | 6.119 | 6.327 | 6.425 | 6.425 | Continuing | Continuing |
| 0000: *JT Non-Lethal Wpns Applied Res* | 0.000 | 5.234 | 6.059 | 5.887 | - | 5.887 | 6.119 | 6.327 | 6.425 | 6.425 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 Non-Lethal Weapons (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-materiel missions; non-lethal acoustic and optical technologies; advanced non-lethal materiels (including materiels 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 Commandant of 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, RDT&E Budget Item Justification: PB 2015 Navy | | | | | Date: March 2014 |
|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | | | R-1 Program Element (Number/Name)<br>PE 0602651M *I JT Non-Lethal Wpns Applied Res* | | |
| **B. Program Change Summary ($ in Millions)** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO** | **FY 2015 Total** |
| Previous President's Budget | 5.973 | 6.060 | 6.194 | - | 6.194 |
| Current President's Budget | 5.234 | 6.059 | 5.887 | - | 5.887 |
| Total Adjustments | -0.739 | -0.001 | -0.307 | - | -0.307 |
| • Congressional General Reductions | - | -0.001 | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | - | - | | | |
| • SBIR/STTR Transfer | -0.229 | - | | | |
| • Rate/Misc Adjustments | 0.001 | - | -0.307 | - | -0.307 |
| • Congressional General Reductions Adjustments | -0.511 | - | - | - | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 2 | R-1 Program Element (Number/Name)<br>PE 0602651M / *JT Non-Lethal Wpns Applied Res* | Project (Number/Name)<br>0000 / *JT Non-Lethal Wpns Applied Res* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000: *JT Non-Lethal Wpns Applied Res* | - | 5.234 | 6.059 | 5.887 | - | 5.887 | 6.119 | 6.327 | 6.425 | 6.425 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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-materiel 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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** (U) JOINT NON-LETHAL WEAPONS | 5.234 | 6.059 | 5.887 |

***FY 2013 Accomplishments:***

- Completed investigation of the characteristics, optimization, and control of Laser Induced Plasma (LIP) phenomena for their nonlethal applications to both counter-personnel and counter-materiel missions. LIP phenomena to be revisited as technology matures.
- Continued refinement of directed energy weapon models through research into non-lethal phenomena and assessment of human effects and weapon effectiveness.
- Continued academic research into technology areas with relevance to non-lethal weapon capabilities.
- Continued investigations of alternative technologies with potential to address emerging capability gaps.
- Continued characterization efforts of alternative directed energy technologies by building upon the Advanced Total Body Model (ATBM), as part of the Human Effects Modeling Analysis Program (HEMAP), to incorporate suitable sensors capable of measuring directed energy effects (millimeter - wave, high powered microwave, etc).
- Continued human effects investigation of alternative physical phenomena to non-lethally suppress humans beyond small arms range.
- Continued investigations of advanced materials and emergent technologies suitable for extended range non-lethal weapon payload applications.
- Continued transition of foundational effects associated with advanced electro-muscular disruption technologies to higher levels of technology development and demonstration.
- Continued applied research for potential emergent technologies with applicability to the clear-a-space counter-personnel mission.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602651M / *JT Non-Lethal Wpns Applied Res* | **Project (Number/Name)**<br>0000 / *JT Non-Lethal Wpns Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Completed transition of foundational effects associated with underwater acoustics bioeffects applied research to higher levels of technology development.<br>- Completed investigation of the characteristics, optimization and control of Laser Induced Plasma (LIP) phenomena as they pertain to the counter-material/counter-aircraft mission application.<br>- Initiated investigation of collateral, non-lethal effects to personnel associated with anticipated employment of maturing counter-material nonlethal weapons technologies.<br>***FY 2014 Plans:***<br>- Continue all efforts from FY 2013, except those noted as completed.<br>- Initiate technologic revisit of using laser induced plasmas to deliver novel NL effects.<br>- Initiate feasibility assessment and evaluation of candidate technologies with potential to mitigate technology challenges impeding NLE capability gap resolution.<br>***FY 2015 Plans:***<br>- Continue all efforts from FY 2014.<br>- Continue incorporation of suitable sensors capable of measuring NL stimuli into surrogate test models as part of the Human Effects Modeling Analysis Program (HEMAP) under PE 0603651M.<br>- Initiate Laser Induced Plasma (LIP) capability to deliver novel NL effects.<br>- Initiate feasibility study of most promising LIP concepts and applications<br>- Initiate evaluation of the feasibility and practicality study of advanced vehicle stopping design concepts.<br>- Initiate investigation of component High Power Microwave (HPM) technologies and transition results to higher levels of technology development and demonstration. | | | |
| **Accomplishments/Planned Programs Subtotals** | 5.234 | 6.059 | 5.887 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**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

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602651M / *JT Non-Lethal Wpns Applied Res* | **Project (Number/Name)**<br>0000 / *JT Non-Lethal Wpns Applied Res* |

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, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | | | | | R-1 Program Element (Number/Name)<br>PE 0602747N *I Undersea Warfare Applied Res* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 86.091 | 103.041 | 86.880 | - | 86.880 | 79.067 | 74.070 | 52.577 | 52.767 | Continuing | Continuing |
| 0000: *Undersea Warfare Applied Res* | 0.000 | 86.091 | 103.041 | 86.880 | - | 86.880 | 79.067 | 74.070 | 52.577 | 52.767 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

FY 2013 funding associated with Future Naval Capability (FNC) efforts are transferring to a new Program Element titled Future Naval Capabilities Applied Research (PE 0602750N). This is to enhance the visibility of the FNC Program by providing an easily navigable overview of all 6.2 FNC investments in a single location.

**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 (Sep 2011). 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. 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, RDT&E Budget Item Justification: PB 2015 Navy | | | | | Date: March 2014 |
|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | | | R-1 Program Element (Number/Name)<br>PE 0602747N *I Undersea Warfare Applied Res* | | |
| **B. Program Change Summary ($ in Millions)** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO** | **FY 2015 Total** |
| Previous President's Budget | 96.814 | 103.050 | 102.354 | - | 102.354 |
| Current President's Budget | 86.091 | 103.041 | 86.880 | - | 86.880 |
| Total Adjustments | -10.723 | -0.009 | -15.474 | - | -15.474 |
| • Congressional General Reductions | - | -0.009 | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | -2.545 | - | | | |
| • SBIR/STTR Transfer | - | - | | | |
| • Program Adjustments | - | - | -15.423 | - | -15.423 |
| • Rate/Misc Adjustments | - | - | -0.051 | - | -0.051 |
| • Congressional General Reductions Adjustments | -8.178 | - | - | - | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 2 | R-1 Program Element (Number/Name)<br>PE 0602747N / *Undersea Warfare Applied Res* | Project (Number/Name)<br>0000 / *Undersea Warfare Applied Res* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000: *Undersea Warfare Applied Res* | - | 86.091 | 103.041 | 86.880 | - | 86.880 | 79.067 | 74.070 | 52.577 | 52.767 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

This PE funds applied research efforts in undersea target detection, classification, localization, tracking, and neutralization. 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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** ANTI-SUBMARINE WARFARE (ASW) DISTRIBUTED SEARCH | 9.094 | 10.949 | 13.490 |
| ***Description:*** ASW Distributed Search focuses on 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 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.<br><br>Funding increase from FY 2014 to FY 2015 is due to realignments required to re-prioritize S&T investments resulting in an increase in ASW Initiatives. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602747N / *Undersea Warfare Applied Res* | **Project (Number/Name)**<br>0000 / *Undersea Warfare Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***FY 2013 Accomplishments:***<br>- Continued development of signal processing algorithms aimed at reducing clutter-generated false alerts.<br>- Continued development/improvement of multi-static signal processing techniques for systems employing coherent sound sources.<br>- Continued development of "intelligent" algorithms aimed at optimizing distributed multistatic sources/receivers<br>Continued a collaborative follow-on Joint Research Project for Next Generation Autonomous Sensing (NGAS).<br>- Continued 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.<br>- Continued development of Non-Traditional Transduction Methods (NTTM) which fundamentally departs from conventional ASW transduction techniques.<br>- Continued development of Non-Acoustic Fiber Optic Sensors (NA-FOS) for ASW applications.<br>- Continued research aimed at adaptive design and synthesis of networked distributed sensors.<br>- Continued effort to demonstrate the effectiveness of structural acoustic-based classifier techniques to detect, localize and identify.<br>- Initiated effort to create compact, low power, highly sensitive directional, and low frequency (10-100 Hz) acoustic sensors.<br>- Complete research and development of feature-based tracking techniques to improve multi-sensor tracking of quiet submarines in littoral and deep-ocean environments.<br>- Complete development of a new structural acoustic technology to detect, localize, and classify low Doppler ASW threats hiding near or on the ocean bottom.<br>- Complete development of robust clutter-control techniques for mid-frequency active sonars based on scatterer physics and sonar performance/parameters.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Complete effort to create compact, low power, highly sensitive directional, and low frequency (10-100 Hz) acoustic sensors.<br>- Initiate development of non-traditional distributed search systems for deployment on air vehicles.<br>- Initiate development of novel parametric source and receiver technologies.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above. | | | |
| ***Title:*** ANTI-SUBMARINE WARFARE (ASW) PRECISION LOCALIZATION | 1.970 | 3.572 | 3.596 |
| ***Description:*** 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 and optical sensing | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602747N / *Undersea Warfare Applied Res* | **Project (Number/Name)**<br>0000 / *Undersea Warfare Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| to highly localize submerged threats. The objective is to increase magnetic sensor range and robustness, enable deployment on Unmanned Air Vehicles (UAVs), and increase optical sensing 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 target acquisition and covert prosecution.<br><br>***FY 2013 Accomplishments:***<br>- Continued development of a non-traditional tracking system for deployment on undersea vehicles.<br>- Continued testing of a non-traditional tracking system.<br>- Continued development of alternative active optical sources and sensor devices for Non-Acoustic ASW systems.<br>- Continued an effort to extend the technology base for blue laser sources for Undersea Warfare applications including underwater communications.<br>- Continued an effort to extend the technology base for high performance electro-optic detectors and filters suitable for Undersea Warfare applications including underwater communications.<br>- Continued an effort to develop consistent and comprehensive modeling and simulation tools for photonic Undersea Warfare and underwater communications components and systems.<br>- Continued an effort to develop optical signal processing and hybrid computing technology appropriate for Undersea Warfare and underwater communications systems.<br>- Continued development of ASW sensor technologies capable of being deployed by a gun or missile launcher<br><br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013.<br>- Initiate development of non-traditional tracking methods and systems for deployment on air vehicles.<br>- Initiate development of low-cost, platform based sensor networks.<br>- Initiate development of quantum sensor technologies for Magnetic Anomaly Detector (MAD).<br><br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014. | | | |
| ***Title:*** ANTI-SUBMARINE WARFARE (ASW) SURVEILLANCE | 60.740 | 69.876 | 53.631 |
| ***Description:*** 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 | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602747N / *Undersea Warfare Applied Res* | **Project (Number/Name)**<br>0000 / *Undersea Warfare Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| 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.<br><br>FY 2014 to FY 2015 decrease is due to the INP LD UUV moving from the 6.2 portion of applied research to the 6.3 applied development portion of the program in PE 0603747N and completion of the ATLAS Imaging Sonar and the Modular Undersea Heavyweight Vehicle (MUHV) efforts.<br><br>***FY 2013 Accomplishments:***<br>- Continued development of Non-Acoustic, Underwater Communications.<br>- Continued development of Advanced Imaging Methods (AIM) to provide expanded spatial, temporal and spectral imaging options.<br>- Continued an effort to research improved seawater electrodes for Underwater Electric Potential (UEP) sensing in ASW applications.<br>- Continued research, the goal of which is to form underwater magnetic sensors into a virtual gradiometric array via non-cabled communications.<br>- Continued development of an acoustic/magnetic hybrid sensor.<br>- Continued development of low cost, compact, combined acoustic sensor.<br>- Continued electroactive polymer smart sensor development.<br>- Continued research to improve detection of quiet, diesel-electric submarines using passive sonar arrays in deep ocean environments.<br>- Continued research to predict performance of automated passive sonar detection and classification algorithms in shallow and deep ocean environments.<br>- Continued biomimetic and nano sensor development.<br>- Continued 'hockey puck' transducer/amplifier module development.<br>- Continued broadband, directional, high power array development.<br>- Continued effort to identify chemical and/or biological signatures that can be exploited to develop underwater non-acoustic sensors for MCM or ASW.<br>- Continued development of a long endurance, air independent energy source for Large UUVs.<br>- Continued development of Autonomy for operation of UUV in the littorals.<br>- Continued development of core UUV technologies to extend the reliability and endurance of UUV operating in the littorals.<br>- Continued at sea testing of prototype LD-UUV technologies. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602747N / *Undersea Warfare Applied Res* | **Project (Number/Name)**<br>0000 / *Undersea Warfare Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued Consortium for Robotics and Unmanned Systems Research (CRUSER) in support of the LD UUV program.<br>- Continued effort to develop a statistical reverberation model that reduces false targets caused by rocky outcrops on the ocean floor to improve torpedo performance.<br>- Continued effort to develop and test waveguide invariant-based methods of depth-classification for quiet submerged targets in littorals.<br>- Completed development of technologies to provide rapid localization of threat submarines for On-Demand Detection, Classification and Localization (On-Demand DCL).<br>- Completed effort to apply compressive sensing techniques to develop algorithms to detect underwater targets using sonar arrays.<br>- Completed development of technologies to provide rapid localization of threat submarines for On-Demand Detection, Classification and Localization (On-Demand DCL).<br>- Completed effort to apply compressive sensing techniques to develop algorithms to detect underwater targets using sonar arrays.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Complete effort to identify chemical and/or biological signatures that can be exploited to develop underwater non-acoustic sensors for MCM or ASW.<br>- Complete effort to develop a statistical reverberation model that reduces false targets caused by rocky outcrops on the ocean floor to improve torpedo performance.<br>- Initiate Modular Undersea Heavyweight Vehicle (MUHV) efforts.<br>- Initiate the development of advanced data exfiltration methods and systems.<br>- Initiate the development of advanced sensor data triage methods and systems.<br>- Initiate the development of highly sparse aperature sensing methods and systems.<br>- Initiate the development of dynamic energy distribution network methods and systems.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Complete effort to develop and test waveguide invariant-based methods of depth-classification for quiet submerged targets in littorals.<br>- Initiate development of long endurance air independent energy source for "SMALL" UUV's and forward deployed sensor nodes.<br>- Initiate development of next generation (non-Penetrating) Power and communications technologies for underwater operations. | | | |
| ***Title:*** MARINE MAMMALS | 3.210 | 4.973 | 2.482 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602747N / *Undersea Warfare Applied Res* | **Project (Number/Name)**<br>0000 / *Undersea Warfare Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Description:*** 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).<br><br>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 PE 0602435N.<br><br>The emphasis of efforts within PE 0602747N Marine Mammals Activity focuses on the effects on the behavior of marine mammals of manmade sound transmitted underwater which includes Integrated Ecosystem Research, Controlled Exposure Experiments (free-ranging US waters), Marine Mammal Hearing, and part of the Monitoring & Detection thrust (Autonomous platform development; gliders, profilers, etc.), Population-level Consequences of Acoustic Disturbance, effects of chronic stress (captive/ modeling studies), and risk assessment modeling.<br><br>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.<br><br>Funding decreases from FY2014 to FY2015 due to completion of studies to examine sensitivity of fish to anthropogenic sound and completion of bioluminescence studies.<br><br>***FY 2013 Accomplishments:***<br>- Continued multi-investigator, coordinated field research to test responses of marine mammals (especially beaked whales) to controlled sound exposures.<br>- Continued 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.<br>- Continued research examining hearing sensitivity of marine mammals (including temporary and permanent threshold shifts).<br>- Continued research efforts examining distributions and abundances of marine mammals relative to prey fields and basic oceanographic parameters.<br>- Continued development of and evaluate models that predict time- and space-dependent sound fields produced by anthropogenic noise sources and mammal responses to the noise.<br>- Continued development and testing of multi-frequency acoustic technologies for detection, identification and enumeration of fish. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602747N / *Undersea Warfare Applied Res* | **Project (Number/Name)**<br>0000 / *Undersea Warfare Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued research to examine sensitivity of fish to anthropogenic sound.<br>- Continued research leading to better predictability of bioluminescent and pigment-bearing planktonic organisms.<br>- Continued research on effects of chronic physiological stress related to acoustic exposure of marine mammals in the wild.<br>- Continued research on the population level consequences of acoustic disturbance to marine mammals.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013.<br>- Complete research to examine sensitivity of fish to anthropogenic sound.<br>- Complete research leading to better predictability of bioluminescent and pigment-bearing planktonic organisms.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above. | | | |
| ***Title:*** UNDERSEA WEAPONRY | 11.077 | 13.671 | 13.681 |
| ***Description:*** 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), Simulation Based Design, 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 and Sea Strike 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), to provide improved platform pre-engagement positioning and fire-control solutions for effective weapon-to-target engagement, and provide countermeasures and counterweapons against current and next-generation undersea weapons.<br>***FY 2013 Accomplishments:***<br>- Continued limited collection and evaluation of small supercavitating vehicle.<br>- Continued CONOPs and tactical-level analysis and employment for advanced undersea weapons.<br>- Initiated concept designs for advanced warheads.<br>- Initiated design/formulation and early-stage testing of propulsion system components for advanced undersea platforms.<br>- Initiated studies, field-test planning and hardware development for Anti-Surface Warfare Weapon Upgrade Program.<br>- Initiated development and testing of technologies for rapid reaction defense against undersea threats.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013.<br>***FY 2015 Plans:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602747N / *Undersea Warfare Applied Res* | **Project (Number/Name)**<br>0000 / *Undersea Warfare Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts of FY 2014. | | | |
| **Accomplishments/Planned Programs Subtotals** | 86.091 | 103.041 | 86.880 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**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, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | **R-1 Program Element (Number/Name)**<br>PE 0602750N *I (U)Future Naval Capabilities Applied Research* |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Program Element | 0.000 | 143.176 | 169.710 | 170.786 | - | 170.786 | 175.936 | 175.954 | 179.122 | 179.155 | Continuing | Continuing |
| 0000: *(U)Future Naval Capabilities Applied Research* | 0.000 | 143.176 | 169.710 | 170.786 | - | 170.786 | 175.936 | 175.954 | 179.122 | 179.155 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

The efforts described in this Program Element (PE) address the Applied Research associated with the Future Naval Capabilities (FNC) Program. The FNC Program represents the requirements-driven, delivery-oriented portion of the Navy Science and Technology (S&T) portfolio. FNC investments respond to Naval S&T Gaps that are identified by the Navy and Marine Corps after receiving input from Naval Research Enterprise (NRE) stakeholders. The Enabling Capabilities (ECs) and associated technology product investments of the FNC Program are competitively selected by a 3-star Technology Oversight Group (TOG), chartered by the S&T Corporate Board and representing the requirements, acquisition, research and fleet/forces communities of the Navy and the Marine Corps.

This was a new PE in FY 2013 that consolidated all Navy 6.2 FNC Program investments into a single Navy 6.2 PE. Marine Corps FNC 6.2 investments are consolidated in a single Marine Corps 6.2 PE (0602131M). In FY 2011 and FY 2012, Navy 6.2 FNC Program investments were spread across 7 separate 6.2 PEs: 0602114N, 0602123N, 0602235N, 0602236N, 0602271N, 0602747N and 0602782N. The consolidation in this PE allows all investments to be viewed by FNC Pillar, Enabling Capability (EC) and Technology Product. It greatly enhances the visibility of the FNC Program by providing an easily navigable overview of all 6.2 FNC investments in a single place.

| B. Program Change Summary ($ in Millions) | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 162.417 | 169.710 | 177.012 | - | 177.012 |
| Current President's Budget | 143.176 | 169.710 | 170.786 | - | 170.786 |
| Total Adjustments | -19.241 | - | -6.226 | - | -6.226 |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | -0.449 | - | | | |
| • SBIR/STTR Transfer | -5.252 | - | | | |
| • Program Adjustments | - | - | -6.162 | - | -6.162 |
| • Rate/Misc Adjustments | - | - | -0.064 | - | -0.064 |

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | Date: March 2014 |
|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | | R-1 Program Element (Number/Name)<br>PE 0602750N *I (U)Future Naval Capabilities Applied Research* | | | |
| • Congressional General Reductions Adjustments | -13.540 | - | - | - | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 2 | R-1 Program Element (Number/Name)<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | Project (Number/Name)<br>0000 / *(U)Future Naval Capabilities Applied Research* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000: *(U)Future Naval Capabilities Applied Research* | - | 143.176 | 169.710 | 170.786 | - | 170.786 | 175.936 | 175.954 | 179.122 | 179.155 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

FNC investments are typically 3-5 years in duration. They provide a continuance of basic research by maturing technologies from a Technology Readiness Level (TRL) of 3 or 4 to a TRL of 6. All FNC products require BA2 and BA3 funded technology development, which is coordinated to ensure tangible technology products are delivered upon completion of each investment. Each year the TOG refreshes the FNC Program by approving new ECs and technology products as older ones get delivered. After transition to an acquisition program, FNC products are further engineered, integrated and, ultimately, delivered to the warfighter. The development and delivery of each FNC product is guided by a Technology Transition Agreement (TTA) that is signed by the requirements and acquisition sponsors, as well as the S&T developer.

This project supports the naval pillars of Capable Manpower, Enterprise and Platform Enablers, Expeditionary Maneuver Warfare, Force Health Protection, Forcenet, Power and Energy, Sea Basing, Sea Shield and Sea Strike. Each of these pillars is listed as a separate R-2 Activity, as is FNC Management. Under each R-2 Activity, the BA 6.2 accomplishments and plans for every Enabling Capability (EC) and Technology Product in the FNC Program are listed. ECs are composed of one or more interrelated technology products, so for clarity, each product is shown under its EC.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** CAPABLE MANPOWER (CMP) | 8.900 | 8.805 | 8.296 |
| ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Capable Manpower (CMP) FNC pillar. The CMP Pillar develops deliverable technologies that provide new capabilities in manpower and personnel management, training and education, and human-systems integration for more intuitive systems. | | | |
| ***FY 2013 Accomplishments:***<br>EC: CMP-FY10-01 Information Architecture for Improved Decision Making<br>- Continue Data Triage - Develop mission performance optimizations that encompass task centered design and advanced human performance modeling to achieve the requisite manning, both in numbers and capabilities, for the complex ships and systems of the future fleet.<br>- Continue Display Information with Uncertainty - Improve the capability to fuse imaging, electronic warfare, and inorganic and acoustic sensor inputs into integrated, fused, and intuitive displays that enhance the presentation and command level understanding of uncertain information. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: CMP-FY10-02 Adaptive Training to Enhance Individual and Team Learning and Performance<br>- Continue Adaptive Training for Combat Information Center Teams - Validate effective and adaptive training system components to enhance individual and team training for surface ship Combat Information Center (CIC) training.<br>- Continue Adaptive Training for Submarine Navigation & Piloting Teams - Validate effective and adaptive training system components to enhance individual and team training for submarine navigation and piloting skills training.<br><br>EC: CMP-FY11-01 Naval Next-generation Immersive Technology (N2IT)<br>- Continue Augmented Immersive Team Training (AITT) - Develop software and hardware to expand training architectures and enablers to enhance training in uncontrolled and uninstrumented locations.<br>- Continue Perceptual Training Systems and Tools (PercepTs) - Identify the perceptual cues in urban and dense infrastructure environments to improve warfighter performance.<br><br>EC: CMP-FY11-02 Performance Shaping Functions for Environmental Stressors<br>- Continue Performance Shaping Functions - Study the impact of incorporating environmental stressors for fatigue, motion, vibration and extreme temperatures into systems engineering tools for the development of complex Navy systems.<br><br>EC: CMP-FY12-01 Live, Virtual, & Constructive Training Fidelity<br>- Continue Cognitive Fidelity Synthetic Environment - Develop optimal characteristics of virtual simulations to elicit the appropriate perceptual/cognitive responses for Naval aviation training.<br>- Continue Tactics & Speech Capable Semi-Automated Forces - Develop virtual constructive representations on live avionics displays.<br>- Continue Virtual-Constructive Representations on Live Avionics Displays - Develop design guidelines for effective and safe representation of virtual and constructive assets on live displays, including developing the symbology used during experimentation and validation efforts.<br><br>EC: CMP-FY13-02 Simulation Toolset for Analysis of Mission, Personnel and Systems (STAMPS)<br>- Initiate/Complete Manpower Planning and Optimization Toolset - Develop methods and models for manpower assessment and allocations.<br>- Initiate Platform Design and Acquisition Toolset - Develop methods and models for manpower assessment and allocation in early platform design.<br>***FY 2014 Plans:***<br>EC: CMP-FY10-01 INFORMATION ARCHITECTURE FOR IMPROVED DECISION MAKING | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete Data Triage - Develop an information architecture that merges the data 'behind the glass' in support of a submarine mission planning toolset.<br>- Complete Display Information with Uncertainty - Develop an intuitive submarine mission planning display that combines navigation planning, intelligence tasking, search planning, bathymetry and operational planning.<br><br>EC: CMP-FY10-02 ADAPTIVE TRAINING TO ENHANCE INDIVIDUAL AND TEAM LEARNING AND PERFORMANCE<br>- Complete Adaptive Training for Combat Information Center Teams - Develop adaptive training system components to enhance individual and team training for surface ship Combat Information Center personnel.<br>- Complete Adaptive Training for Submarine Navigation & Piloting Teams - Develop an operator assessment framework that consists of performance measures, performance algorithms, and expert models to help instructors better judge performance and provide tailored, meaningful feedback to the sailor.<br><br>EC: CMP-FY11-01 NAVAL NEXT-GENERATION IMMERSIVE TECHNOLOGY (N2IT)<br>- Continue Augmented Immersive Team Training (AITT) - Identify perceptual cues and expand the virtual training architecture for immersive training in urban and dense infrastructure environments.<br>- Continue Perceptual Training Systems and Tools (PercepTs) - Identify the perceptual cues in the urban and dense infrastructure and environment that may improve warfighter performance.<br><br>EC: CMP-FY11-02 PERFORMANCE SHAPING FUNCTIONS FOR ENVIRONMENTAL STRESSORS<br>- Complete Performance Shaping Functions - Evaluate the impact of incorporating environmental stressors (fatigue, motion, vibration and extreme temperatures) into systems engineering tools for the development of complex Navy systems.<br><br>EC: CMP-FY12-01 LIVE, VIRTUAL, & CONSTRUCTIVE TRAINING FIDELITY<br>- Continue Cognitive Fidelity Synthetic Environment - Develop optimal characteristics for virtual simulations to elicit the appropriate perceptual-cognitive responses for Naval aviation training.<br>- Continue Tactics & Speech Capable Semi-Automated Forces - Conduct applied research to develop learner-aware semi autonomous forces.<br>- Continue Virtual-Constructive Representations on Live Avionics Displays - Develop design guidelines for effective and safe representation of virtual and constructive assets on live displays.<br><br>EC: CMP-FY13-02 SIMULATION TOOLSET FOR ANALYSIS OF MISSION, PERSONNEL AND SYSTEMS (STAMPS)<br>- Continue Platform Design and Acquisition Toolset - Develop methods and models to identify the crew capabilities required to operate a specific ship design during various missions under varying physical and cognitive loads. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: CMP-FY14-02 UNMANNED AERIAL SYSTEMS INTERFACE, SELECTION AND TRAINING TECHNOLOGIES (U-ASISTT)<br>- Initiate Dynamic, Adaptive & Modular Training for Unmanned Aerial Systems (UAS) - Characterize knowledge structures for semi-automated forces source data.<br>- Initiate Selection for UAS Personnel (SUPer) - Characterize the knowledge skills and abilities required for operating Navy unmanned aircraft systems.<br>- Initiate Unmanned Aerial Systems (UAS) Control Station Human Machine Interface - Identify the core platform-common and platform-specific information requirements leading to successful unmanned aircraft system operation. | | | |
| ***FY 2015 Plans:***<br>EC: CMP-FY11-01 NAVAL NEXT-GENERATION IMMERSIVE TECHNOLOGY (N2IT)<br>- Complete Augmented Immersive Team Training (AITT) - Design and demonstrate software technology to deliver augmented reality scenarios tailored to the skills of the training audience for infantry operations.<br>- Complete Perceptual Training Systems and Tools (PercepTs) - Identify the perceptual cues in the urban and dense infrastructure environments that may improve warfighter performance.<br><br>EC: CMP-FY12-01 LIVE, VIRTUAL, & CONSTRUCTIVE TRAINING FIDELITY<br>- Continue Cognitive Fidelity Synthetic Environment - Develop optimal characteristics for virtual simulations to elicit the appropriate perceptual-cognitive responses for Naval aviation training.<br>- Continue Tactics & Speech Capable Semi-Automated Forces - Conduct applied research to develop learner-aware semi-autonomous forces.<br>- Continue Virtual-Constructive Representations on Live Avionics Displays - Develop design guidelines for effective and safe representation of virtual and constructive assets on live displays.<br><br>EC: CMP-FY13-02 SIMULATION TOOLSET FOR ANALYSIS OF MISSION, PERSONNEL AND SYSTEMS (STAMPS)<br>- Continue Manpower Planning and Optimization Toolset - Develop analytical techniques, data collection methodologies, and procedures to create optimized manpower requirements for the platform.<br>- Continue Platform Design and Acquisition Toolset - Develop scenario-based models that characterize crew performance to operate ship systems during 60/90 day missions under varying physical and cognitive loads.<br><br>EC: CMP-FY14-02 UNMANNED AERIAL SYSTEMS INTERFACE, SELECTION AND TRAINING TECHNOLOGIES (U-ASISTT)<br>- Continue Dynamic, Adaptive & Modular Training for UAS - Expand Activity Learning capability to allow automatic matching between UAS operator training objectives, specific training contexts, and semi-automated forces behaviors.<br>- Continue Selection for UAS Personnel (SUPer) - Develop mission scenarios to enable testing for the knowledge, skills and abilities required for operating Navy unmanned aircraft systems and integrate into an appropriate UAS simulator. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue UAS Control Station Human Machine Interface - Develop metrics that assess UAS Operator performance in terms of the likelihood of leading to successful unmanned aircraft system operation.<br><br>EC: CMP-FY15-01 ACCELERATING DEVELOPMENT OF SMALL UNIT DECISION MAKERS (ADSUDM)<br>- Initiate Decision Making-Learning Management System (DM-LMS) - Identify S&T solutions for Decision Making (DM) and instructional method guidelines and develop software products to plan, assess, and track decision making skill development.<br>- Initiate Digital Integrated Representation of Tactical Environment (DIRTE) - Identify S&T solutions for classroom and sustainment training and develop rapid terrain modeling and sketchpad software products to enable small unit leaders and instructors to create effective decision making environments and scenarios.<br>- Initiate Simulation Tailored Training and Assessment (ST2A) - Identify S&T solutions for situated tutor techniques and unobtrusive monitoring techniques and develop software and hardware prototypes to execute a decision making program of instruction and scenarios in simulation.<br><br>EC: CMP-FY15-02 ENVIRONMENT DESIGNED TO UNDERTAKE COUNTER A2AD TACTICS TRAINING & EXPERIMENTATION (EDUCAT2E)<br>- Initiate Environment Designed to Undertake Counter A2AD Tactics Training & Experimentation (EDUCAT2E) - Investigate and develop an approach to an objective, metrics-driven training and experimentation capability for Fast Attack Craft and Mine Warfare threats. | | | |
| ***Title:*** ENTERPRISE AND PLATFORM ENABLERS (EPE) | 12.381 | 16.724 | 12.357 |
| ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Enterprise and Platform Enablers (EPE) FNC pillar. The EPE Pillar develops cross-cutting, deliverable technologies that provide new capabilities for naval service platforms that lower acquisition, operations and maintenance costs, improve system safety and availability, and improve platform survivability.<br><br>The FY 2013 to FY 2014 increase is due to the initiation of EPE-FY14-02 and EPE-FY15-03.<br><br>The FY 2014 to FY 2015 decrease was due primarily to the completion of EPE-FY10-01, EPE-FY10-02 and EPE-FY11-01, and the planned ramp-down of EPE-FY10-03, EPE-FY12-01 and EPE-FY13-01.<br><br>***FY 2013 Accomplishments:***<br>EC: EPE-FY09-01 Affordable Common Radar Architecture<br>- Complete Affordable Common Radar Architecture - Develop software and components for a low cost surface radar replacement. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: EPE-FY09-03 Air Platforms Safety and Affordability Technologies<br>- Complete Adaptive Expert System for the Autonomous Detection of Aviation Mishap Leading Indicators - Investigate adaptive expert systems to automatically and rapidly analyze aircrew performance to detect human factors related to mishap leading indicators.<br>- Complete Advanced Rotor Blade Erosion Protection - Conduct materials research for developing robust erosion resistant systems for the MV-22 aircraft.<br><br>EC: EPE-FY09-07 Affordable Submarine Propulsion and Control Actuation<br>- Continue Advanced Material Propeller - Conduct Applied Research to understand the effects of failure mechanisms, shock, and fluid-structure interaction on composite marine propellers.<br><br>EC: EPE-FY10-01 Advanced Shipboard Water Desalination<br>- Continue Desalination System - Conduct Applied Research to understand fouling and maintenance issues for reverse osmosis systems and approaches to mitigate these problems.<br>- Continue Pretreatment System - Conduct Applied Research to understand fouling and maintenance issues for pretreatment systems and operational approaches to mitigate these problems.<br><br>EC: EPE-FY10-02 Affordable Modular Panoramic Photonics Mast<br>- Continue Compact Hyper-spectral Scanning Imager - Conduct Applied Research of shortwave infrared hyperspectral sensors to detect anomalies and targets.<br>- Continue Compact Low Light Level Shortwave Infrared (SWIR) Video Camera - Develop highly sensitive shortwave infrared sensors to detect anomalies and targets.<br>- Continue Modular Photonics Mast Housing - Develop technology to reduce the fabrication and life cycle costs of the SSN/SSGN next generation photonics mast.<br><br>EC: EPE-FY10-03 Corrosion and Corrosion Related Signature Technologies for Increased Operational Availability<br>- Continue Advanced Active Shaft Grounding System (ASGS)/Shaft Current Sensor - Develop an advanced active shaft grounding system with integrated shaft current sensing and extremely low frequency electromagnetic control.<br>- Continue Advanced-Robust Impressed Current Cathodic Protection (ICCP) Anodes and Reference Cells - Develop novel impressed current cathodic protection anodes, reference cells and sensors with high mean time between failure.<br>- Continue Dual-Use Corrosion/Signature Sensor for Ballast Tanks - Develop dual-use impressed current cathodic protection and novel sensor technology for corrosion-based maintenance and closed-loop deamping to extend hull-ballast coating longevity and reduce recalibration frequency. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: EPE-FY11-01 Flight Deck Thermal Management<br>- Complete Advanced Thermal Management System - Develop materials and processes for a thermal management system.<br>- Continue Integrated Thermal Management System Design - Finish large panel construction and initiation of a land-based demonstration of large thermal management system panels.<br><br>EC: EPE-FY12-01 Corrosion Mitigation Technologies and Design Integration<br>- Continue Corrosion Resistant Surface Treatment - Determine interstitial hardening parameters for improved corrosion resistance and surface hardness to materials in erosion-corrosion environments.<br>- Continue Sprayable Acoustic Damping Systems - Develop synthesis of sprayable acoustic damping resin systems for future application in submarine acoustic damping for reduced costs and maintenance.<br><br>EC: EPE-FY12-02 Integrated Hybrid Structural Management System (IHSMS)<br>- Continue Distributed Structural Micro-Sensor Nodes - Conduct research in wireless energy harvesting sensors, architecture, and diagnostics for rotorcraft structural health management.<br>- Continue Rotor - Hot Spot Sensors and Integration - Evaluate and optimize rotor-hot spot sensors and integration technologies that allow improved health assessment of rotating frame and selected structural hot spots.<br><br>EC: EPE-FY13-01 Towed Array System Reliability Improvement<br>- Initiate Tools for Predicting Array Operational Loading & Distribution - Develop an analytical modeling tool for predicting the magnitude and distribution of forces on the array and cable as a function of system design and operational environment. | | | |
| ***FY 2014 Plans:***<br>EC: EPE-FY09-07 AFFORDABLE SUBMARINE PROPULSION AND CONTROL ACTUATION<br>- Continue Advanced Material Propeller - Conduct applied research to understand the failure mechanisms, cavitation erosion, shock, and fluid-structure interaction on composite marine propellers and develop predictive capability of these phenomena.<br><br>EC: EPE-FY10-01 ADVANCED SHIPBOARD WATER DESALINATION<br>- Complete Advanced Navy Reverse Osmosis System (formerly known as both Desalination System and Pretreatment System)<br>- Conduct Applied Research to understand fouling and maintenance issues for shipboard Reverse Osmosis desalination/ pretreatment systems and operational approaches to mitigate these problems.<br><br>EC: EPE-FY10-02 AFFORDABLE MODULAR PANORAMIC PHOTONICS MAST<br>- Complete Compact Hyper-spectral Scanning Imager - Develop and integrate camera electronics, optics, scanner, imaging chips, and algorithms for a hyper-spectral imager providing low noise and high spectral fidelity in a small form factor. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete Compact Low Light Level Short, Wavelength Infrared (SWIR) Video Camera - Develop and integrate a Low Light Level Short, Wavelength Infrared (SWIR) Video Camera for an Affordable Modular Panoramic Photonics Mast.<br>- Complete Modular Photonics Mast Housing - Develop, fabricate, and integrate panoramic headwindows into a prototype for an Affordable Modular Panoramic Photonics Mast.<br><br>EC: EPE-FY10-03 CORROSION AND CORROSION RELATED SIGNATURE TECHNOLOGIES FOR INCREASED OPERATIONAL AVAILABILITY<br>- Complete Advanced Active Shaft Grounding System (ASGS)/Shaft Current Sensor - Evaluate system interaction with Impressed Current Cathodic Protection (ICCP) control.<br>- Complete Dual-Use Corrosion/Signature Sensor for Ballast Tanks - Complete development of analysis and control methods to negate current flow and maintain corrosion control.<br>- Continue Advanced-Robust Impressed Current Cathodic Protection (ICCP) Anodes and Reference Cells - Conduct scale modeling to define optimum routing of cables to minimize corrosion related magnetic signature.<br><br>EC: EPE-FY11-01 FLIGHT DECK THERMAL MANAGEMENT<br>- Continue Integrated Thermal Management System Design - Test panels for heat transfer capabilities.<br><br>EC: EPE-FY12-01 CORROSION MITIGATION TECHNOLOGIES<br>- Continue Corrosion Resistant Surface Treatment - Develop a single step treatment to eliminate the need for pre- and post-processes.<br>- Continue Sprayable Acoustic Damping Systems - Verify damping characteristics and complete evaluation of corrosion properties and application methodologies.<br><br>EC: EPE-FY12-02 INTEGRATED HYBRID STRUCTURAL MANAGEMENT SYSTEM (IHSMS)<br>- Continue Distributed Structural Micro-Sensor Nodes - Conduct research in wireless energy harvesting sensors and other advanced sensors, architectures, and diagnostics technologies for rotorcraft structural health management.<br>- Continue Rotor - Hot Spot Sensors and Integration - Evaluate and optimize rotor-hot spot sensors and integration technologies that allow improved health assessment of rotating frame and selected structural hot spots.<br><br>EC: EPE-FY13-01 TOWED ARRAY SYSTEM RELIABILITY IMPROVEMENT<br>- Continue Tools for Predicting Array Operational Loading & Distribution - Move from Phase I to Phase II of the model development effort building upon the initial effort to incorporate global/multi-scale models and coupling on the array under all operating conditions | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: EPE-FY14-02 ALUMINUM ALLOY CORROSION CONTROL AND PREVENTION<br>- Initiate Aluminum Alloy Corrosion Mitigation Technologies - Formulate coatings and investigate coating properties on corrosion inhibition, degree of thermal load reduction, and adhesion over Al 5XXX alloys.<br>- Initiate Aluminum Alloy Corrosion Prediction Tool - Develop algorithm for Al 5XXX alloy evaluation and for prediction of time-to-failure.<br><br>EC: EPE-FY15-02 GAS TURBINE UPGRADES FOR REDUCED TOTAL OWNERSHIP COST (TOC) AND IMPROVED SHIP IMPACT<br>- Initiate Shipboard Gas Turbine Marinization Package for Higher Temperature, Higher Pressure Operation - Conduct Navy gas turbine hot corrosion analysis and experimentation under shipboard environmental conditions and power scales.<br><br>EC: EPE -FY15-03 SPECIAL HULL TREATMENT<br>- Initiate New Materials Development and Laboratory Characterization- Begin applied research.<br>***FY 2015 Plans:***<br>EC: EPE-FY09-07 AFFORDABLE SUBMARINE PROPULSION AND CONTROL ACTUATION<br>- Complete Advanced Material Propeller - Assess blade/hub joint strength, perform blade fatigue and deflection testing, and static and dynamic testing of the complex hub unit.<br><br>EC: EPE-FY10-03 CORROSION AND CORROSION RELATED SIGNATURE TECHNOLOGIES FOR INCREASED OPERATIONAL AVAILABILITY<br>- Complete Advanced-Robust ICCP Anodes and Reference Cells - Complete reference cell laboratory performance testing and down select.<br><br>EC: EPE-FY11-01 FLIGHT DECK THERMAL MANAGEMENT<br>- Complete Integrated Thermal Management System Design - Test panels for heat transfer capabilities.<br><br>EC: EPE-FY12-01 CORROSION MITIGATION TECHNOLOGIES<br>- Continue Corrosion Resistant Surface Treatment - Complete development of single-step treatment.<br>- Continue Sprayable Acoustic Damping Systems - Complete corrosion testing of prototype Sprayable Acoustic Damping system.<br><br>EC: EPE-FY12-02 INTEGRATED HYBRID STRUCTURAL MANAGEMENT SYSTEM (IHSMS)<br>- Continue Distributed Structural Micro-Sensor Nodes - Conduct research in wireless energy harvesting sensors and other advanced sensors, architectures, diagnostics and prognostics technologies for rotorcraft structural health management. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Rotor - Hot Spot Sensors and Integration - Evaluate and optimize rotor-hot spot sensors and integration technologies that allow improved health assessment of rotating frame and selected structural hot spots.<br><br>EC: EPE-FY13-01 TOWED ARRAY SYSTEM RELIABILITY IMPROVEMENT<br>- Continue Tools for Predicting Array Operational Loading & Distribution - Develop individual predictive models for hydrodynamic effects on a towed array that include the forces imparted on a towed array by the handling system and the effects of the combined forces on array internal components.<br><br>EC: EPE-FY14-02 ALUMINUM ALLOY CORROSION CONTROL AND PREVENTION<br>- Continue Aluminum Alloy Corrosion Mitigation Technologies - Continue coating formulation and evaluate properties.<br>- Continue Aluminum Alloy Corrosion Prediction Tool - Develop algorithm for 5000 series aluminum alloy degree of sensitization and for prediction of Mean Time to Repair.<br><br>EC: EPE-FY15-02 GAS TURBINE UPGRADES FOR REDUCED TOTAL OWNERSHIP COST (TOC) AND IMPROVED SHIP IMPACT<br>- Continue Shipboard Gas Turbine Marinization Package for Higher Temperature, Higher Pressure Operation - Conduct Navy gas turbine hot corrosion analysis and experimentation under shipboard environmental conditions and power scales.<br><br>EC: EPE-FY15-03 SPECIAL HULL TREATMENT<br>- Continue New Material(s) Development & Lab Characterization - Develop new materials mitigation technology for submarines. | | | |
| ***Title:*** EXPEDITIONARY MANEUVER WARFARE (EMW) | 6.357 | 9.297 | 6.741 |
| ***Description:*** This R-2 Activity contains all Navy funded Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Expeditionary Maneuver Warfare (EMW) FNC Pillar. The EMW Pillar develops deliverable technologies that provide new capabilities in expeditionary maneuver warfare, including naval ground forces, with special emphasis on regular and irregular warfare in urban environments and combating terrorism.<br><br>The FY 2013 to FY 2014 increase was due to the initiation of EMW-FY14-01.<br><br>The FY 2014 to FY 2015 decrease was due primarily to the planned ramp-down of EMW-FY12-02.<br><br>***FY 2013 Accomplishments:***<br>EC: EMW-FY12-02 Future Joint Counter Radio-Controlled Improvised Explosive Devices (C-RCIED) Electronic Warfare (JCREW) | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Distributed C-RCIED - Develop advanced techniques for networking distributed counter-radio controlled Improvised Explosive Device (IED) resources.<br>- Continue Integrated Counter-RCIED EW (ICEW) - Develop advanced techniques for defeating radio controlled Improvised Explosive Devices (IEDs) and achieving interoperable communications and electronic warfare capabilities.<br><br>EC: EMW-FY13-01 Azimuth and Inertial MEMS Navigation System<br>- Initiate MEMS Inertial Navigation System - Characterize the operational limitations and shortcomings of the digital magnetic compass and optimize sensor performance of MEMS to reduce target location error in the navigation system of hand-held targeting systems.<br>***FY 2014 Plans:***<br>EC: EMW-FY12-02 FUTURE JOINT COUNTER RADIO-CONTROLLED IMPROVISED EXPLOSIVE DEVICE ELECTRONIC WARFARE (JCREW)<br>- Continue Distributed Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (D-JCREW) - Develop techniques for real-time networking and cross-platform synchronization of distributed Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (JCREW) platforms for improved efficiency and coordinated tasking.<br>- Continue Integrated Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (I-JCREW) - Develop techniques for improving compatibility between Radio Frequency (RF) systems, particularly jammers and communications, in order to allow continuous operations of each in a shared battlespace.<br><br>EC: EMW-FY13-01 AZIMUTH AND INERTIAL MICRO-ELECTRO-MECHANICA SYSTEM (MEMS) NAVIGATION SYSTEM<br>- Complete Micro-Electro-Mechanical System (MEMS) Inertial Navigation System - Characterize the operational limitations and shortcomings of the digital magnetic compass and optimize sensor performance of MEMS to reduce target location error in the Navigation System of hand-held targeting systems.<br><br>EC: EMW-FY14-01 SPECTRAL AND RECONNAISSANCE IMAGERY FOR TACTICAL EXPLOITATION (SPRITE)<br>- Initiate Automated Processing for Spectral Exploitation and Dissemination (APSED) - Conduct a feasibility effort to develop an Electro-Optical (EO) and Hyper-Spectral Imagery (HSI) image processing architecture that includes EO-to-HSI cross-correlation and fusion, image archiving and retrieval, and exploitation product generation.<br>- Initiate Compact Wide Area Reconnaissance and Spectral Sensor (CWARSS) - Initiate efforts to develop a wide-area intelligence, surveillance and reconnaissance capability with simultaneous high spatial and spectral resolution.<br>***FY 2015 Plans:***<br>EC: EMW-FY12-02 FUTURE JOINT COUNTER RADIO-CONTROLLED IED ELECTRONIC WARFARE (JCREW) | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Distributed Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (D-JCREW) - Develop distributed resource allocation and RF situational awareness techniques to provide automated tactical-level distributed jamming on multiple ground-based EW systems.<br>- Continue Integrated Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (I-JCREW) - Develop components and techniques to enable simultaneous transmission and reception of EW and blue-force communication waveforms.<br><br>EC: EMW-FY14-01 SPECTRAL AND RECONNAISSANCE IMAGERY FOR TACTICAL EXPLOITATION (SPRITE)<br>- Continue Automated Processing for Spectral Exploitation and Dissemination (APSED) - Conduct a feasibility effort to develop an Electro-Optical (EO) and Hyper-Spectral Imagery (HSI) image processing architecture that includes EO-to-HSI cross-correlation and fusion, image archiving and retrieval, and exploitation product generation.<br>- Continue Compact Wide Area Reconnaissance and Spectral Sensor (CWARSS) - Complete preliminary hardware design for a wide-area intelligence, surveillance and reconnaissance capability with simultaneous high spatial and spectral resolution. | | | |
| ***Title:*** FNC MANAGEMENT | 8.476 | 9.028 | 10.782 |
| ***Description:*** This R-2 Activity includes the Science and Technology (S&T) analyses and studies required to take new Future Naval Capabilities (FNC) Program Enabling Capabilities (ECs) approved by the Technology Oversight Group and produce the detailed technology specifications and performance metrics needed to procure the component level technologies that must be developed and tested in order to deliver technology products to the acquisition community. This activity includes development and implementation of innovative and dynamically changing technology management business processes required to manage FNC investments supporting the naval capability pillars.<br><br>The FY 2014 FY 2015 increase was due to a Technology Oversight Group decision to delay the start of some ECs which required ONR to align additional FY15 new start preparation funds to accommodate an increased number of ECs expected to receive initial technical funds.<br><br>***FY 2013 Accomplishments:***<br>FNC Management<br>- Continue Enabling Capability New Start Preparations - Conduct technology analysis and studies to support the development and validation of technology performance specifications to ensure new enabling capabilities are able to commence execution in a timely manner.<br>- Continue Support/Operations (OPS) Analysis - Conduct warfighter sustainment Applied Research and analysis, including technology management of FNC investments supporting the naval capability pillars.<br>***FY 2014 Plans:***<br>EC: FNC MGMT-NEW START PREPARATIONS | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue FNC Management - New Start Preparations - Conduct technology analysis and studies to support the development and validation of technology performance specifications to ensure new enabling capabilities are able to commence execution in a timely manner.<br><br>EC: FNC MGMT-SUPPORT/OPS ANALYSIS<br>Continue FNC Management - Support/OPS Analysis - Conduct warfighter sustainment Applied Research and analysis, including technology management of FNC investments supporting the naval capability pillars.<br><br>***FY 2015 Plans:***<br>FNC MGMT-NEW START PREPARATIONS<br>- Continue FNC Management - New Start Preparations - Conduct technology analysis and studies to support the development and validation of technology performance specifications to ensure new enabling capabilities are able to commence execution in a timely manner.<br><br>FNC MGMT-SUPPORT/OPS ANALYSIS<br>- Continue FNC Management - Support/OPS Analysis - Conduct warfighter sustainment Applied Research and analysis, including technology management of FNC investments supporting the naval capability pillars. | | | |
| ***Title:*** FORCE HEALTH PROTECTION (FHP)<br><br>***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Force Health Protection (FHP) FNC pillar. The FHP Pillar develops deliverable technologies that provide new capabilities that provide Sailors and Marines with the best possible protection from operational threats by reducing morbidity and mortality when casualties occur.<br><br>The FY 2013 to FY 2014 decrease was due primarily to the completion of FHP-FY08-03 and FHP-FY08-04, and the planned ramp-down of FHP-FY10-01 and FHP-FY11-01.<br><br>***FY 2013 Accomplishments:***<br>EC: FHP-FY08-01 Casualty Prevention<br>- Complete Models of Head and Cervical Spine - Conduct preclinical animal and post-mortem human specimen testing of tissue failure and strain rates.<br><br>EC: FHP-FY08-02 Advanced Forward Care<br>- Complete Closed Loop Fluid Delivery System - Develop physiologically-based software algorithms to perform constant monitoring of patient condition and render the proper fluid resuscitation. | 11.161 | 10.106 | 9.219 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete Non-Pulmonary Oxygenation - Develop the requisite formulation of hydrogen-peroxide to produce a constant concentration of oxygen during a Casualty Evacuation (CASEVAC) scenario.<br><br>EC: FHP-FY08-03 Rapid Blood Treatment<br>- Complete Hemostatic Agents - Conduct biochemical analysis of the efficacy of hemostatic materials as determined by platelet aggregation.<br>- Complete Pharmacologic Resuscitation - Conduct feasibility testing of the use of low-volume resuscitation in severe hemorrhage models.<br><br>EC: FHP-FY08-04 Warfighter Restoration<br>- Complete Hearing Loss Prevention and Treatment - Conduct data collection and determination of appropriate technologies for the purposes of noise dosimetry and personal protection from noise.<br>- Complete Post Traumatic Stress Mitigation - Conduct research that will support the development of stress resilience technologies, including stress resilience, physiological markers of stress/resilience, studies on the effects of fatigue, and pilot information on the effectiveness of interventions.<br>- Complete Repetitive Neurotrauma Mitigation - Identify molecular markers of mild Traumatic Brain Injury (mTBI).<br>- Complete Wound Healing - Determine the optimal drug and delivery combination for restoring muscle and bone.<br><br>EC: FHP-FY10-01 Human Injury & Treatment Model<br>- Continue Human Injury & Treatment Model - Develop a model for predicting outcomes of personnel exposure to shipboard damage.<br><br>EC: FHP-FY11-01 Multifunctional Blood Substitute (MFBS)<br>- Continue Multifunctional Blood Substitute (MFBS) - Determine the optimal blood component mixture for a complete and shelf-stable resuscitation fluid.<br><br>EC: FHP-FY12-01 Automated Critical Care System (ACCS)<br>- Continue Automated Critical Care System (ACCS) - Develop physiologically-based software algorithms to perform constant monitoring of 15 patient conditions and render the proper treatment for all conditions monitored during a 2-6 hour Casualty Evacuation (CASEVAC) scenario.<br><br>EC: FHP-FY12-02 Saving lives with Emergency Medical Perfluorocarbons in the Field (SEMPer Fi) for Sea, Air & Land Dysoxia.<br>- Continue SEMPer Fi for Air Dysoxia - Conduct advanced preclinical to early clinical studies on safety, efficacy and dosing of therapeutics for the immediate treatment of pulmonary hypoxia/hypoxemia. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue SEMPer Fi for Land Blast Kit - Conduct advanced preclinical to early clinical studies on safety, efficacy and dosing of targeted therapeutics or immediate treatment of blast overpressure, including injury to the brain and/or internal organs.<br><br>EC: FHP-FY13-03 Extreme Operations: Mitigating Oxygen Imbalance at Altitude and at Depth<br>- Initiate Hypoxia Alert and Mitigation System - Conduct cognitive assessment of performance under hypoxic conditions.<br>***FY 2014 Plans:***<br>EC: FHP-FY10-01 HUMAN INJURY & TREATMENT MODEL<br>- Complete Human Injury & Treatment Model - Complete the model for predicting outcomes of personnel exposure to shipboard damage.<br><br>EC: FHP-FY11-01 MULTIFUNCTIONAL BLOOD SUBSTITUTE (MFBS)<br>- Continue Multifunctional Blood Substitute (MFBS) - Determine the optimal blood component mixture for a complete and shelf stable resuscitation fluid.<br><br>EC: FHP-FY12-01 AUTOMATED CRITICAL CARE SYSTEM (ACCS)<br>- Continue Automated Critical Care System (ACCS) - Formulate autonomous hardware and software system to monitor and maintain combat causalities with minimal human intervention during a 2-6 hour Casualty Evacuation (CASEVAC) scenario.<br><br>EC: FHP-FY12-02 SAVING LIVES WITH EMERGENCY MEDICAL PERFLUOROCARBONS IN THE FIELD (SEMPER FI) FOR SEA, AIR & LAND DYSOXIA<br>- Continue Saving Lives with Emergency Medical Perfluorocarbons in the Field (SEMPer Fi) for Air Dysoxia - Perform down-select of candidate drugs based on small and large animal testing for treatment of pulmonary hypoxia/hypoxemia.<br>- Continue Saving Lives with Emergency Medical Perfluorocarbons in the Field (SEMPer Fi) for Land Blast Kit - Determine window of therapeutic intervention and dosing for immediate treatment of blast overpressure in small and large animals, including injury to the brain and/or internal organs.<br><br>EC: FHP-FY13-03 EXTREME OPERATIONS: MITIGATING OXYGEN IMBALANCE AT ALTITUDE AND AT DEPTH<br>- Continue Hypoxia Alert and Mitigation System - Evaluate and adapt methods of detecting individual-specific detriments in performance in hypoxic conditions.<br><br>EC: FHP-FY14-01 ACUTE CARE COVER FOR SEVERELY INJURED LIMBS (ACCSIL)<br>- Initiate Acute Care Cover for Severely Injured Limbs (ACCSIL) - Establish efficacy test parameters for innovative pharmaceutical solutions and novel materials for feasibility of use. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: FHP-FY14-03 BLAST LOAD ASSESSMENT: SENSE AND TEST (BLAST)<br>- Initiate Algorithm - Determine, establish and design test parameters of algorithm.<br>- Initiate Neuro-Functional Assessment Tool - Establish and design a repeatable sensory modality.<br>- Initiate Sensor - Determine and establish sensor metrics.<br>***FY 2015 Plans:***<br>EC: FHP-FY12-01 AUTOMATED CRITICAL CARE SYSTEM<br>- Continue Automated Critical Care System (ACCS) - Formulate autonomous hardware and software system to monitor and maintain combat causalities with minimal human intervention during a 2-6 hour Casualty Evacuation (CASEVAC) scenario.<br><br>EC: FHP-FY12-02 SAVING LIVES WITH EMERGENCY MEDICAL PERFLUOROCARBONS IN THE FIELD (SEMPER FI) FOR SEA, AIR & LAND DYSOXIA<br>- Complete SEMPer Fi for Air Dysoxia - Perform down-select of candidate drugs based on small and large animal testing for treatment of pulmonary hypertension.<br>- Continue SEMPer Fi for Land Blast Kit - Determine window of therapeutic intervention and dosing with hypothermia for immediate treatment of blast overpressure in small and large animals, including injury to the brain and/or internal organs.<br><br>EC: FHP-FY13-03 EXTREME OPERATIONS: MITIGATING OXYGEN IMBALANCE AT ALTITUDE AND AT DEPTH<br>- Continue Hypoxia Alert and Mitigation System - Test algorithms to detect/predict onset of hypoxia or hypoxia-like symptoms for mountain operators, casualties, and aviators.<br><br>EC: FHP-FY14-01 ACUTE CARE COVER FOR SEVERELY INJURED LIMBS (ACCSIL)<br>- Continue Acute Care Cover for Severely Injured Limbs (ACCSIL) - Establish efficacy test parameters for a fieldable wound cover to include novel outer cover materials and internal pharmaceutical coating that improve the clinical outcome of severe wounds.<br><br>EC: FHP-FY14-03 BLAST LOAD ASSESSMENT: SENSE AND TEST (BLAST)<br>- Continue Algorithm - Determine, establish and design test parameters for an algorithm that integrates blast intensity data with cognitive impairment data to predict likelihood of brain injury after a given blast event.<br>- Neuro-Functional Assessment Tool - Establish testing paradigm and sensory modality for a non-psychometric device that detects and estimates severity of traumatic brain injury.<br>- Continue Sensor - Develop metrics for a self powered blast sensor that detects and quantifies acceleration, pressure, and impulse from a given blast event and outputs the data electronically. | | | |
| ***Title:*** FORCENET (FNT) | 27.938 | 36.050 | 28.295 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Forcenet (FNT) FNC Pillar. The FNT pillar develops deliverable technologies that provide new capabilities in Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), networking, navigation, sensors, decision support, cyber-space, intelligence, and space technologies that will provide the architectural framework for naval warfare in the information age.

The FY 2013 to FY 2014 increase was due primarily to the initiation of FNT-FY13-03, FNT-FY14-02 and FNT-FY14-03.

The FY 2014 to FY 2015 decrease was due to the completion of FNT-FY10-01, FNT-FY10-02 and FNT-FY10-03, and the planned ramp-down of FNT-FY11-01, FNT-FY11-02 and FNT-FY12-01.

***FY 2013 Accomplishments:***
EC: FNT-FY09-02 Dynamic Tactical Communications Networks
- Complete Assured information exchange - Develop capabilities for strict priority queuing, adaptive routing and route control agent mechanisms.
- Complete Self-Organizing Networks - Develop policy-based network management, mobile adhoc networking routing enhancements, radio-router interfaces, and dynamic routing across in-line network encrypters.

EC: FNT-FY09-04 Dynamic Command and Control (C2) for Tactical Forces and Maritime Operations Center (MOC)
- Complete Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC) - Conduct Applied Research for the timely and accurate sharing of information between Combat Systems and Tactical Command and Control through disconnected, intermittent, and limited communications.

EC: FNT-FY10-01 High-bandwidth Free-space Lasercomm
- Complete Free-space Optical Terminal (FOT) - Develop free space optical terminal components supporting the development of an active optical communication system.
- Complete Modulating Retro-reflector Unit (MRU) - Develop modulating retro-reflector components supporting the development of a passive optical communication system.

EC: FNT-FY10-02 Actionable Intelligence Enabled by Persistent Surveillance
- Continue Autonomous UAV Collision Avoidance System (ACAS) - Develop light weight, low cost sensor components and autonomy algorithms to enable detection and avoidance of all classes of aircraft or unmanned aerial vehicles.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Operational Adaptation Enterprise Services - Develop an information enterprise for the organization of contextual Resource Description Framework (RDF) statements for rapid association of data into meaningful graphs and of application services that could be orchestrated in near real-time for hybrid complex operations.<br>- Continue Ultra Wide Field-of-View (FOV) Area Surveillance System - Develop unmanned aerial vehicle deployable Electro-Optic / Infrared (EO/IR) sensor components for adaptable wide and narrow fields-of-view.<br><br>EC: FNT-FY10-03 SATCOM Vulnerability Mitigation<br>- Continue Airborne Communications Suite (ACS) - Develop algorithms for fast switching phased arrays suitable for use on aircraft and radio architectures and prototype interim common data link radio units suitable for aircraft.<br><br>EC: FNT-FY11-01 Pro-Active Computer Network Defense and Information Assurance<br>- Continue Common Operational Security Decision System - Develop a real-time network topology map and visualization model for identifying and displaying network activity.<br>- Continue Next Generation Security and Security Management Protocols - Develop real-time system and autonomous control models for network security components.<br>- Continue Next Generation Sensors and Gateways - Develop real-time malicious code detection and remediation algorithms for network data.<br><br>EC: FNT-FY11-02 Fast Magic<br>- Continue Fast Magic Product 1 - Conduct Applied Research. (details classified)<br>- Continue Fast Magic Product 2 - Conduct Applied Research. (details classified)<br><br>EC: FNT-FY11-05 NRL Space<br>- Continue Multi-INT Tracking - Conduct Applied Research in the emerging area of vessel tracking.<br>- Continue Tagging - Develop data tags based on key parametric values used in the Maritime environment.<br><br>EC: FNT-FY12-01 Advanced Tactical Data Link (ATDL)<br>- Continue Mission Based Waveform Controls and Networking - Develop waveform controls and networking capabilities to support integrated systems.<br><br>EC: FNT-FY12-02 Autonomous Persistent Tactical Surveillance<br>- Continue Autonomous Information-Based Surveillance Control - Develop algorithms for information based collection and planning. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Contextual Enterprise Information - Conduct Applied Research to provide enterprise exploitation services for situation context between relevant theater sensor collections and exploitation products.<br>- Continue Mobile Autonomous Intelligence Surveillance Reconnaissance (ISR) to Command and Control (C2) Synchronization<br>- Conduct Applied Research to develop enterprise distributed software that will manage complex event processing and temporal modeling of the ISR to C2 time link budget.<br><br>EC: FNT-FY13-01 EW Battle Management for Surface Defense<br>- Initiate Electronic Warfare Battle Management (EWBM) - Conduct Applied Research on the application of multi-variable discrete optimization for distributed surface platforms in support of electronic warfare battle management.<br><br>EC: FNT-FY13-04 Detection and Fusion for Remote Sensors<br>- Initiate Adaptive Multi-Int Correlation & Identification (AMICA) - Conduct Applied Research for the integration of emerging Information Operations (IO) and new sensors at the tactical level.<br>- Initiate Detection & Classification Algorithms (DCA) - Begin development of detection and classification algorithms. | | | |
| ***FY 2014 Plans:***<br>EC: FNT-FY10-02 ACTIONABLE INTELLIGENCE ENABLED BY PERSISTENT SURVEILLANCE<br>- Complete Autonomous Unmanned Aerial Vehicle (UAV) Collision Avoidance System - Develop and integrate a prototype with lab-test hardware, software, and subsystems for collision avoidance of Unmanned Air Systems in the National Airspace System (NAS).<br>- Complete Operational Adaptation Enterprise Services - Develop an information enterprise for the organization of contextual Resource Description Framework statements for rapid association of data into meaningful graphs and application services that could be orchestrated in near real-time for hybrid complex operations.<br>- Complete Ultra Wide Field of View (FOV) Area Surveillance System - Develop and integrate lab-test algorithms and individual components of the sensor system.<br><br>EC: FNT-FY10-03 SATELLITE COMMUNICATIONS (SATCOM) VULNERABILITY MITIGATION<br>- Complete Multi-Link Common Data Link (CDL) System - Complete supporting architecture, Radio Frequency (RF) distribution, and networking technology developments needed for a Multi-Link Common Data Link (CDL) System.<br><br>EC: FNT-FY11-01 PRO-ACTIVE COMPUTER NETWORK DEFENSE AND INFORMATION ASSURANCE<br>- Continue Common Operational Security Decision System -Develop techniques for assessing the impact of network security policy on network operations. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Next Generation Security and Security Management Protocols - Develop techniques for evaluating the security and performance of network communication paths to support fault-aware overlay routing.<br>- Continue Next Generation Sensors and Gateways - Develop techniques for modeling network behavior, identifying abnormal events, and deriving corrective transformations.<br><br>EC: FNT-FY11-02 FAST MAGIC<br>- Continue Fast Magic Product 1 - Conduct Applied Research (details classified).<br>- Continue Fast Magic Product 2 - Conduct Applied Research (details classified).<br><br>EC: FNT-FY11-05 NRL SPACE<br>- Continue Multi-INT Tracking - Develop vessel tracking algorithms and characterization techniques.<br>- Continue Tagging - Perform data tagging research based on key parametric values used in the Maritime environment.<br><br>EC: FNT-FY12-01 ADVANCED TACTICAL DATA LINK (ATDL)<br>- Continue Mission-Based Waveform Controls & Networking - Emulate preliminary design to validate performance against operational scenarios.<br><br>EC: FNT-FY12-02 AUTONOMOUS PERSISTENT TACTICAL SURVEILLANCE<br>- Continue Autonomous Information-Based Surveillance Control - Analyze and continue development of improved algorithms and processing for information based collection and planning.<br>- Continue Contextual Enterprise Information - Develop the analytical services framework, including enterprise exploitation services for situation context between relevant theater sensor collections and exploitation products.<br>- Continue Mobile Autonomous Intelligence, Surveillance and Reconnaissance (ISR) to Command and Control (C2) Synchronization - Conduct applied research to develop enterprise distributed software that will manage complex event processing and temporal modeling of the Intelligence, Surveillance and Reconnaissance (ISR) to Command and Control (C2) time link budget.<br><br>EC: FNT-FY13-01 ELECTRONIC WARFARE BATTLE MANAGEMENT (EWBM) FOR SURFACE DEFENSE<br>- Continue Electronic Warfare Battle Management (EWBM) - Develop coordinated Electronic Attack and deception (decoy) techniques to include novel use of existing hardware capabilities in real time necessary to manage the Electronic Warfare (EW) battle space.<br><br>EC: FNT-FY13-03 SILK THREAD<br>- Initiate Product 1 - Conduct applied research (details classified). | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate Product 2 - Conduct applied research (details classified).<br><br>EC: FNT-FY13-04 DETECTION AND FUSION FOR REMOTE SENSORS<br>- Continue Adaptive Multi-Int Correlation & Identification (AMICA) - Research and analyze algorithms to enable cross-domain information fusion and optimize use of remote sensing assets.<br>- Continue Detection & Classification Algorithms (DCA) - Research and analyze algorithms to provide enhanced detection and classification metrics and robust performance under stressing environmental conditions.<br><br>EC: FNT-FY14-02 ADAPTIVE TASKING, COLLECTION, PROCESSING, EXPLOITATION AND DISSEMINATION (TCPED) SERVICES<br>- Initiate Adaptive Tasking, Collection, Processing, Exploitation and Dissemination (TCPED) for Anti-Submarine Warfare (ASW) Services - Develop advanced techniques for automated, high accuracy, low error rate, adaptive processing.<br>- Initiate Data Exfiltration and Networked Platform Interaction - Details classified.<br>***FY 2015 Plans:***<br>EC: FNT-FY11-01 PRO-ACTIVE COMPUTER NETWORK DEFENSE AND INFORMATION ASSURANCE<br>- Complete Common Operational Security Decision System - Develop interactive controls for map-based visualization of Computer Network Defense policy deployments.<br>- Complete Next Generation Security and Security Management Protocols - Develop path-aware trusted routing algorithm for maximizing Information Assurance of security management communications.<br>- Complete Next Generation Sensors and Gateways - Develop adaptive learning and decision algorithms for pro-active defense mechanisms and for creating Computer Network Defense policy.<br><br>EC: FNT-FY11-02 FAST MAGIC<br>- Complete Fast Magic Product 1 - Conduct applied research.<br>- Complete Fast Magic Product 2 - Conduct applied research.<br><br>EC: FNT-FY11-05 NRL SPACE<br>- Complete Multi-INT Tracking - Develop vessel tracking algorithms and characterization techniques.<br>- Complete Tagging - Perform data tagging research based on key parametric values used in the Maritime environment.<br><br>EC: FNT-FY12-01 ADVANCED TACTICAL DATA LINK (ATDL)<br>- Continue Mission-Based Waveform Controls & Networking - Develop baseline waveforms and validate performance against operational scenarios. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: FNT-FY12-02 AUTONOMOUS PERSISTENT TACTICAL SURVEILLANCE<br>- Continue Autonomous Information-Based Surveillance Control - Develop algorithms for information based UAV routing and patching.<br>- Continue Contextual Enterprise Information - Develop the analytical services framework, including enterprise exploitation services for situation context between relevant theater sensor collections and exploitation products.<br>- Continue Mobile Autonomous ISR to C2 Synchronization - Develop enterprise distributed software solution that will model mission tracks, translate these tracks to information tracks, and produce relevant information fulfillment and deficit objects.<br><br>EC: FNT-FY13-01 EW BATTLE MANAGEMENT FOR SURFACE DEFENSE<br>- Continue EW Battle Management (EWBM) - Develop data exchange message techniques and new algorithms for control and coordination of distributed EW assets.<br><br>EC: FNT-FY13-04 DETECTION AND FUSION FOR REMOTE SENSORS<br>- Continue Adaptive Multi-Int Correlation & Identification (AMICA) - Research and analyze algorithms to enable cross-domain information fusion and optimize use of remote sensing assets.<br>- Continue Detection & Classification Algorithms (DCA) - Research and analyze algorithms to provide enhanced detection and classification metrics and robust performance under stressing environmental conditions.<br><br>EC: FNT-FY14-02 ADAPTIVE TASKING, COLLECTION, PROCESSING, EXPLOITATION AND DISSEMINATION (TCPED) SERVICES<br>- Continue Adaptive TCPED for ASW Services - Develop and evaluate the performance of methods that are context aware and determine the value of information for a mission.<br>- Continue Data Exfiltration and Networked Platform Interaction - Develop components and design methods leading to a low cost radio that meets size, weight, and power constraints.<br><br>EC: FNT-FY15-01 ADVANCED AIRBORNE EARLY WARNING ELECTRONIC PROTECTION (AAEWEP)<br>- Initiate Advanced AEW Electronic Protection - Develop techniques to improve E2-D electronic protection.<br><br>EC: FNT-FY15-02 DATA FOCUSED NAVAL TACTICAL CLOUD<br>- Initiate ASW Naval Tactical Cloud - Perform the data science activities to ingest all relevant data (acoustic, IR, EO, magnetic, radar, SIGINT, METOC) into the Naval Tactical Cloud to enable efficient decision support analytics in support of effective ASM mission execution based on Commander's Intent. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate EXW Naval Tactical Cloud - Design the services needed for an additive capability to the Naval tactical cloud, specifically an expeditionary warfare mission overwatch system capable of finalizing mission templates and serving as a decision aid during mission execution.<br>- Initiate IAMD Naval Tactical Cloud - Perform the data science activities necessary to ingest relevant data (e.g. ISR sensors, NTM, Intel, METOC, etc.) and design of advanced analytics for enhanced situational awareness and improved IAMD mission execution effectiveness.<br><br>EC: FNT-FY15-04 SCALABLE INTEGRATED RF SYSTEM FOR UNDERSEA PLATFORMS (SIRFSUP)<br>- Initiate Compact, Scalable Integrated RF (Compact-SIRF) - Develop techniques for high speed data conversion and processing between Radio Frequency (RF) collection and digital processing systems using low size, weight and power RF analog and digital designs.<br>- Initiate Electronic Warfare Tactical Decision Aid (EW-TACAID) - Develop performance measures and expert models that provide meaningful feedback to the EW operator and develop an intuitive EW display.<br>- Initiate Scalable Integrated RF for Submarines (SIRF-Sub) - Develop techniques for high speed data conversion and processing between RF collection and digital processing systems. | | | |
| ***Title:*** POWER AND ENERGY (P&E) | 4.098 | 5.530 | 8.435 |
| ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Power and Energy (P&E) FNC pillar. The P&E Pillar develops deliverable technologies that provide new capabilities in energy security, efficient power and energy systems, high energy and pulse power.<br><br>The FY 2013 to FY 2014 increase was due to the initiation of P&E-FY14-01.<br><br>The FY 2014 to FY 2015 increase was due primarily to the initiation of P&E-FY15-03.<br><br>***FY 2013 Accomplishments:***<br>EC: P&E-FY12-01 Renewable-Sustainable Expeditionary Power<br>- Continue Renewable Thermal Engine - Conduct research of sustainable energy technologies for mobile tactical applications.<br><br>EC: P&E-FY12-03 Long Endurance Undersea Vehicle Propulsion<br>- Continue Air Independent Propulsion System - Develop full-scale air independent energy system detailed design, technical-cost analysis, and initiate full-scale component procurements.<br>***FY 2014 Plans:***<br>EC: P&E-FY12-01 RENEWABLE-SUSTAINABLE EXPEDITIONARY POWER | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Renewable Thermal Engine - Continue detailed design for integration of component technologies including connections and user interfaces/controls.<br><br>EC: P&E-FY12-03 LONG ENDURANCE UNDERSEA VEHICLE PROPULSION<br>- Continue Air Independent Propulsion System - Finalize Energy System layout drawings of critical components, interfaces and subsystems integrated into the Unmanned Underwater Vehicle (UUV) hull.<br><br>EC: P&E-FY14-01 EFFICIENT AND POWER DENSE ARCHITECTURE AND COMPONENTS<br>- Initiate High Power Solid State Circuit Protection for Power Distribution and Energy Storage -<br>Conduct trade study to investigate suitable circuit protection methods and create analytical models of their operation.<br><br>***FY 2015 Plans:***<br>EC: P&E-FY12-01 RENEWABLE-SUSTAINABLE EXPEDITIONARY POWER<br>- Continue Renewable Thermal Engine - Conduct test planning for integration of component technologies including test methods, procedures, facilities, and schedule.<br><br>EC: P&E-FY12-03 LONG ENDURANCE UNDERSEA VEHICLE PROPULSION<br>- Continue Air Independent Propulsion System - Develop Standard Operating Procedures, maintenance schedules, system piping and instrumentation diagrams, and system components for an Unmanned Undersea Vehicle energy section.<br><br>EC: P&E-FY14-01 EFFICIENT AND POWER DENSE ARCHITECTURE AND COMPONENTS<br>- Continue High Power Solid State Circuit Protection for Power Distribution and Energy Storage - Assess circuit protection analytic model results, pursue circuit protection component and system design for Phase 1, and initiate Phase 2 model development for components and system circuit protection.<br><br>EC: P&E-FY15-03 MULTIFUNCTION ENERGY STORAGE FOR NAVY / USMC APPLICATIONS TO MAXIMIZE OPERATIONAL EFFECTIVENESS AND EFFICIENCY<br>- Initiate Compact High Density Tactical Energy Storage - Conduct evaluation of conceptual multifunction energy storage module technologies and overall operational modeling analysis.<br>- Initiate Multi-Function High Density Shipboard Energy Storage - Conduct full-scale ship multifunctional energy storage module analysis and evaluation of conceptual multifunction energy storage module technologies. | | | |
| ***Title:*** SEA BASING (BAS) | 9.213 | 2.577 | 5.750 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Sea Basing (BAS) FNC pillar. The BAS Pillar develops deliverable logistics, shipping and at-sea transfer technologies that provide new capabilities for projecting expeditionary force from the sea base and providing sea based joint operational independence through improved connector, at-sea transfer and shipboard logistical capabilities.<br><br>The FY 2013 to FY 2014 decrease was due to the completion of BAS-FY08-03 and a planned ramp-down of the Advanced Mooring System product within BAS-FY11-01.<br><br>The FY 2014 to FY 2015 increase was due a ramp-up of BAS-FY11-01 to ensure it could finish in early FY 2016.<br><br>***FY 2013 Accomplishments:***<br>EC: BAS-FY08-03 Sense and Respond Logistics<br>- Complete Common Operating Picture Logistics Decision Support Tool - Develop software to perform human cognitive functions for logistics planning decision support.<br><br>EC: BAS-FY11-01 Connectors and the Sea Base<br>- Continue Advanced Mooring System - Construct vacuum mooring and motion control components.<br>- Continue Environmental Ship Motion Forecasting - Conduct research on sensing and wave and ship motion sensing and forecasting.<br>***FY 2014 Plans:***<br>EC: BAS-FY11-01 CONNECTORS AND THE SEA BASE<br>- Complete Advanced Mooring System - Conduct research on vacuum mooring and motion control components.<br>- Continue Environmental Ship Motion Forecasting - Conduct research on sensing and wave and ship motion sensing and forecasting.<br>***FY 2015 Plans:***<br>EC: BAS-FY11-01 CONNECTORS AND THE SEA BASE<br>- Complete Environmental Ship Motion Forecasting - Develop environmental and ship motion sensor and forecasting components. | | | |
| ***Title:*** SEA SHIELD (SHD) | 33.808 | 39.204 | 46.486 |
| ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Sea Shield (SHD) FNC pillar. The SHD Pillar develops deliverable technologies that provide new capabilities in theater air and missile defense, anti-submarine warfare, mine countermeasures, defensive surface warfare, global defensive assurance, anti-terrorism, and fleet/force protection. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

The FY 2013 to FY 2014 increase was due primarily to the initiation of SHD-FY14-02, SHD-FY14-04 and SHD-FY14-08, and the planned ramp-up of SHD-FY11-01 and SHD-FY13-05.

The FY 2014 to FY 2015 increase was due primarily to the initiation of SHD-FY15-07.

***FY 2013 Accomplishments:***
EC: SHD-FY09-01 Operation of ASW Active Distributed Systems
- Complete Mobile System Placement, Source Control, and Pattern Keeping Algorithm - Develop algorithms used to coordinate the search and track capability between mobile, low frequency active Anti-Submarine Warfare (ASW) systems.

EC: SHD-FY09-06 Countermeasure Technologies for Anti-Ship Missile Defense (ASMD)
- Complete Enhanced SEWIP Transmitter - Conduct a final test of the enhanced Surface Electronic Warfare Improvement Program (SEWIP) transmit array in the anechoic chamber.

EC: SHD-FY09-08 Four-Torpedo Salvo Defense
- Complete Anti Torpedo Torpedo (ATT) for Surface Ship Defense against Complex Salvo - Develop software encoded algorithms for the anti-torpedo torpedo sensor and controller enabling engagement of torpedo salvoes of up to four attacking units.

EC: SHD-FY10-01 Anti-Ship Missile Defense Technologies (Hardkill)
- Continue Enhanced Lethality Guidance Algorithms (ELGA) - Design and model STANDARD Missile guidance algorithms for advanced maneuvering missile threats.
- Continue Enhanced Maneuverability Missile Airframe (EMMA) - Design and model STANDARD Missile motor and control techniques for advanced maneuvering threats.

EC: SHD-FY10-02 High Fidelity Active Sonar Training
- Continue ASW Command Level Training - Develop algorithms for training ASW Commanders by utilizing human cognitive factors and evaluate them in the laboratory for performance improvement.
- Continue Operator Training - Develop algorithms to enhance the realism of simulated submarine targets, environmental clutter and reverberation, and evaluate their laboratory performance.

EC: SHD-FY10-03 Advanced Sonar Technology for High Clearance Rate Mine Countermeasures (MCM)
- Continue Integrated Forward Looking Sonar - Dual Frequency Synthetic Aperture Sonar (FLS-DFSAS) - Develop autonomy, automatic target recognition and real-time change detection, including conducting laboratory/pond data collection.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Long Range Low Frequency Broad Band (LFBB) Sonar (Autonomous Underwater Vehicle (AUV) Platform Option) - Conduct long range acoustics experiments and develop classification algorithms.<br>- Continue Very Shallow Water (VSW) Acoustic Color/Imaging Sonar - Develop acoustic color/synthetic aperture sonar imaging algorithms and performance of controlled data collection.<br><br>EC: SHD-FY10-04 Next Generation Countermeasure Technologies for Ship Missile Defense<br>- Continue Next Generation Countermeasure Technologies for Ship Missile Defense - Develop distributed resource optimization and coordinated electronic attack techniques for ship missile defense.<br><br>EC: SHD-FY10-05 Affordable Vector Sensor Towed Array and Signal Processing<br>- Continue Vector Sensor Towed Array - Develop component level technology for use in a thin-line Vector Sensor Towed Array and develop a physics-based performance model.<br>- Continue Vector Sensor Towed Array Signal Processing - Develop the noise reduction and passive signal processing algorithms unique to a thin line Vector Sensor Towed Array.<br><br>EC: SHD-FY11-01 Torpedo Common Hybrid Fuzing System<br>- Continue Torpedo Common Hybrid Fuzing System - Conduct developmental simulation and testing.<br><br>EC: SHD-FY11-02 Integrated Hardkill-Softkill<br>- Complete Integrated Active and Electronic Defense (IAED) - Design and model optimized response combinations of kinetic and non-kinetic anti-ship missile defenses.<br><br>EC: SHD-FY12-01 Force Level Radar Resource Management for Integrated Air and Missile Defense (IAMD)<br>- Continue Radar Resource Manager for Integrated Air & Missile Defense (IAMD) - Design and model algorithms for management and coordination of force level AEGIS radar resources.<br><br>EC: SHD-FY12-03 Sonar Automation<br>- Continue Active Sonar Automation - Identify and evaluate in lab performance of algorithms to improve active sonar operator performance in detecting submarines while reducing false contact rates.<br>- Continue Passive Sonar Automation - Identify and evaluate in laboratory performance of algorithms that improve passive sonar operator performance against quiet submarines in the presence of clutter.<br><br>EC: SHD-FY12-04 Detection and Neutralization of Near-Surface Drifting-Oscillating Mines<br>- Continue Compact Modular Sensor-Processing Suite (CMSS) - Develop target recognition algorithms. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

EC: SHD-FY13-01 Cooperative Networked Radar
- Initiate Cooperative Networked Radar - Develop software and algorithms to integrate multiple shipboard radars.

EC: SHD-FY13-02 Ground Based Air Defense On-the-Move (GBAD-OTM)
- Initiate/Complete GBAD-OTM High Energy Laser Demonstrator - Conduct Applied Research supporting development of a radar-cued high energy laser system capable of detecting low radar cross section threats and perform soft and hard kills of unmanned aerial systems while on-the-move.

EC: SHD-FY13-05 High Altitude ASW (HAASW) from the P-8
- Initiate Next Generation Multistatic Active Capability (NGMAC) - Identify and evaluate transducer source level improvements and conduct early development work on algorithms capable of providing state estimation for use in multi-static active coherent buoys.
- Initiate Unmanned Targeting Air System (UTAS) - Identify and evaluate magnetic sensors and algorithms for use on an unmanned aerial vehicle for localization of a submarine.

EC: SHD-FY13-07 USV Payloads for Single Sortie Mine Countermeasures
- Initiate Drifting Mine Neutralization Technology - Develop low-cost sensing solutions, algorithm development, and associated autonomy.
- Initiate MCM Payload Automation - Develop command and control, planning and recognition algorithms and models.
- Initiate Single Sortie MCM Detect-to-Engage Payload - Develop architecture, command and control, planning algorithms and design options for hardware.

***FY 2014 Plans:***
EC: SHD-FY10-01 ANTI-SHIP MISSILE DEFENSE TECHNOLOGIES
- Continue Enhanced Lethality Guidance Algorithms (ELGA) - Continue design and modeling of STANDARD Missile guidance algorithms for advanced maneuvering missile threats.
- Continue Enhanced Maneuverability Missile Airframe (EMMA) - Continue design and modeling STANDARD Missile motor and thrust vector control for advanced maneuvering threats.

EC: SHD-FY10-02 HIGH FIDELITY ACTIVE SONAR TRAINING
- Complete Anti-Submarine Warfare (ASW) Command Level Training - Develop algorithms for training Anti-Submarine Warfare (ASW) Commanders and their Aircraft Carrier supporting personnel by utilizing human cognitive factors and evaluating them in the laboratory for performance improvements.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete Operator Training - Develop algorithms to enhance the realism of simulated submarine targets, environmental clutter and reverberation, and evaluate their laboratory performance.<br><br>EC: SHD-FY10-03 ADVANCED SONAR TECHNOLOGY FOR HIGH CLEARANCE RATE MINE COUNTERMEASURES (MCM)<br>- Continue Long Range Low Frequency Broadband (LFBB) Sonar (Autonomous Underwater Vehicle (AUV) Platform Option) - Develop detection and classification algorithms for stealthy mines.<br>- Complete Integrated Forward looking Sonar - Dual Frequency Synthetic Aperture Sonar (FLS-DFSAS) - Develop autonomy, automatic target recognition and real-time change detection, including conducting laboratory/pond data collection.<br>- Complete Very Shallow Water (VSW) Acoustic Color/Imaging Sonar - Develop acoustic color/synthetic aperture sonar imaging algorithms and performance of controlled data collection.<br><br>EC: SHD-FY10-04 NEXT GENERATION COUNTERMEASURE TECHNOLOGIES FOR SHIP MISSILE DEFENSE<br>- Complete Next Generation Countermeasure Technologies for Ship Missile Defense - Develop, test and modify algorithms to allow networked, multi-platform Electronic Attack (EA) control to deliver synchronized jamming and deception effects to counter emergent anti-ship missile target prosecution modalities.<br><br>EC: SHD-FY10-05 AFFORDABLE VECTOR SENSOR TOWED ARRAY AND SIGNAL PROCESSING<br>- Continue Vector Sensor Towed Array - Develop component level technology for use in a thin-line Vector Sensor Towed Array and develop a physics-based performance model.<br>- Continue Vector Sensor Towed Array Signal Processing - Develop the noise reduction and passive signal processing algorithms unique to a thin-line Vector Sensor Towed Array.<br><br>EC: SHD-FY11-01 TORPEDO COMMON HYBRID FUZING SYSTEM<br>- Continue Torpedo Common Hybrid Fuzing System - Conduct developmental simulations and testing.<br><br>EC: SHD-FY12-01 FORCE LEVEL RADAR RESOURCE MANAGEMENT FOR INTEGRATED AIR AND MISSILE DEFENSE (IAMD)<br>- Continue Radar Resource Manager for Integrated Air and Missile Defense (IAMD) - Design and model algorithms for management and coordination of force level AEGIS radar resources.<br><br>EC: SHD-FY12-03 SONAR AUTOMATION<br>- Continue Active Sonar Automation - Evaluate in lab performance of algorithms to improve active sonar operator performance in detecting submarines while reducing false contact rates. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Passive Sonar Automation - Evaluate in laboratory performance of algorithms that improve passive sonar operator performance against quiet submarines in the presence of clutter.<br><br>EC: SHD-FY12-04 DETECTION AND NEUTRALIZATION OF NEAR-SURFACE DRIFTING-OSCILLATING MINES<br>- Continue Compact Modular Sensor-Processing Suite (CMSS) - Develop target recognition algorithms.<br><br>EC: SHD-FY13-01 COOPERATIVE NETWORKED RADAR<br>- Continue Cooperative Networked Radar - Develop, collect, and process real-world data to integrate multiple shipboard radars.<br><br>EC: SHD-FY13-05 HIGH ALTITUDE ANTI-SUBMARINE WARFARE (HAASW) FROM THE P-8<br>- Continue Next Generation Multistatic Active Capability (NGMAC) - Identify and evaluate transducer source level improvements and conduct early development work on algorithms capable of providing state estimation for use in multi-static active coherent sonobuoys.<br>- Continue Unmanned Targeting Air System (UTAS) - Identify and evaluate magnetic sensors and algorithms for use on an unmanned aerial vehicle for locating a submarine.<br><br>EC: SHD-FY13-07 UNMANNED SURFACE VEHICLE (USV) PAYLOADS FOR SINGLE SORTIE MINE COUNTERMEASURES<br>- Continue Drifting Mine Neutralization Technology - Develop low-cost sensing solutions, algorithm development, and associated autonomy.<br>- Continue Mine Countermeasure (MCM) Payload Automation - Develop command and control, planning and recognition algorithms and models.<br>- Continue Single Sortie Mine Countermeasure (MCM) Detect-to-Engage Payload - Develop architecture, command and control, planning algorithms and design options for hardware.<br><br>EC: SHD-FY14-02 FULL SECTOR TORPEDO DEFENSE<br>- Initiate ATT Timeline Compression (ATTTC) - Begin algorithm development.<br>- Continue Concept C Countermeasure - Finalize requirements definition and performance prediction.<br>- Continue HVU Mounted Sonar - Conduct requirements studies and ship scope checks.<br><br>EC: SHD-FY14-04 ADVANCED UNDERSEA WEAPON SYSTEM (AUWS)<br>- Initiate Autonomous Threat Detection and Localization - Develop sensor architecture, algorithms and fusion methodology for autonomously detecting and tracking targets in real-time.<br>- Initiate Remote Command & Control - Develop communications protocols and algorithms to assure the exchange of messages between sensor nodes and with the weapon node, on demand. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate Tactical Positioning & Fire Control - Develop Advanced Undersea Weapon System (AUWS) algorithms for positioning the sensor, weapon and gateway nodes, efficiently combining intra-node information, and autonomously generating an effective weapon fire solution.<br><br>EC: SHD-FY14-08 TIER 3 HIGH VALUE UNIT (HVU) SELF-DEFENSE<br>- Initiate Adaptive Hypothesis-based Fire Control - Design and model fire control solutions using modern electronic support data.<br>- Initiate Advanced ESSM Guidance - Design and model guidance algorithms to increase lethality over the maximum outer self-defense kinematic envelope.<br><br>EC: SHD-FY15-07 HYPER VELOCITY PROJECTILE<br>- Initiate Hyper Velocity Projectile - Demonstrate the component technology required to support hypervelocity launch and common interfaces for powder gun and railgun launch conditions.<br>- Initiate Advanced Rolling Airframe Missile (RAM) Block 2 Guidance - Design and model guidance algorithms to increase lethality over the maximum inner self-defense kinematic envelope.<br>***FY 2015 Plans:***<br>EC: SHD-FY10-01 ANTI-SHIP MISSILE DEFENSE TECHNOLOGIES<br>- Continue Enhanced Lethality Guidance Algorithms (ELGA) - Develop STANDARD missile guidance algorithm to support the dual-pulse rocket motor.<br>- Continue Enhanced Maneuverability Missile Airframe (EMMA) - Develop a dual-pulse rocket motor for STANDARD missile.<br><br>EC: SHD-FY10-03 ADVANCED SONAR TECHNOLOGY FOR HIGH CLEARANCE RATE MCM<br>- Continue Long Range LFBB Sonar (AUV Platform Option) - Demonstrate and refine detection & classification algorithms for stealthy mines.<br><br>EC: SHD-FY10-05 AFFORDABLE VECTOR SENSOR TOWED ARRAY AND SIGNAL PROCESSING<br>- Complete Vector Sensor Towed Array - Evaluate and deliver component technology for thin-line Vector Sensor Towed Array (VSTA), common array acoustic modules, and a validated physics-based VSTA performance model.<br>- Complete Vector Sensor Towed Array Signal Processing - Evaluate and report sonar signal processing detection performance from at-sea and laboratory test events and assess hardware implications for the processing strategy.<br><br>EC: SHD-FY11-01 TORPEDO COMMON HYBRID FUZING SYSTEM<br>- Complete Torpedo Common Hybrid Fuzing System - Conduct developmental simulation and testing. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: SHD-FY12-01 FORCE LEVEL RADAR RESOURCE MANAGEMENT FOR INTEGRATED AIR AND MISSILE DEFENSE (IAMD)<br>- Continue Radar Resource Manager for IAMD - Develop algorithms to provide dynamic force-level management and coordination of radar tracks.<br><br>EC: SHD-FY12-03 SONAR AUTOMATION<br>- Continue Active Sonar Automation - Identify and evaluate in lab performance of algorithms to improve active sonar operator performance in detecting submarines while reducing false contact rates.<br>- Continue Passive Sonar Automation - Identify and evaluate the in-laboratory performance of algorithms that improve passive sonar operator against quiet submarines in the presence of clutter.<br><br>EC: SHD-FY12-04 DETECTION AND NEUTRALIZATION OF NEAR-SURFACE DRIFTING-OSCILLATING MINES<br>- Continue Compact Modular Sensor-Processing Suite (CMSS) - Develop processing & data fusion for onboard classification.<br><br>EC: SHD-FY13-01 COOPERATIVE NETWORKED RADAR<br>- Continue Cooperative Networked Radar - Develop techniques for cross platform radar operation.<br><br>EC: SHD-FY13-05 HIGH ALTITUDE ASW (HAASW) FROM THE P-8<br>- Continue Next Generation Multistatic Active Capability (NGMAC) - Develop algorithms for use in the Multistatic Active Capability system that improve performance, reduce operator workload, and allow for use in all ocean environments.<br>- Continue Unmanned Targeting Air System (UTAS) - Update vehicle noise models and coordinate with Magnetic Anomaly Detection algorithms.<br><br>EC: SHD-FY13-07 USV PAYLOADS FOR SINGLE SORTIE MINE COUNTERMEASURES<br>- Continue USV-based Mine Neutralization (formerly called Drifting Mine Neutralization Technology) - Develop low-cost sensing, navigation, and battle damage assessment solutions, algorithm development, and associated autonomy.<br>- Continue MCM Payload Automation - Develop planning and automatic target recognition algorithms for risk-based MCM.<br>- Continue Single Sortie MCM Detect-to-Engage Payload - Develop architecture, command and control, planning algorithms and design options for hardware.<br><br>EC: SHD-FY14-02 FULL SECTOR TORPEDO DEFENSE<br>- Continue ATT Timeline Compression (ATTTC) - Perform technology requirements definition, algorithm development, and performance prediction for acoustic illumination and engagement controller.<br>- Continue Concept C Countermeasure - Perform technology requirements definition. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue HVU Mounted Sonar - Conduct requirements studies and ship scope checks.<br><br>EC: SHD-FY14-04 ADVANCED UNDERSEA WEAPON SYSTEM (AUWS)<br>- Continue Autonomous Threat Detection and Localization - Model the AUWS sensor architecture, target detection and tracking algorithms and fusion methodology, and conduct simulation testing.<br>- Continue Remote Command & Control - Model the AUWS sensor, weapon and gateway communications protocols and algorithms, and conduct simulation testing.<br>- Continue Tactical Positioning & Fire Control - Model the AUWS node positioning and management algorithms for effective fire control, and conduct simulation testing.<br><br>EC: SHD-FY14-08 TERMINATOR (T3)<br>- Continue Adaptive Hypothesis-based Fire Control - Develop a hypothesis-based algorithm to provide a fire control solution against a missile defense threat.<br>- Continue Advanced ESSM Guidance - Develop guidance modifications to the Evolved Sea Sparrow Missile.<br>- Continue Advanced RAM Block 2 Guidance - Develop guidance modifications to the Rotating Airframe Missile.<br><br>EC: SHD-FY15-07 HYPER VELOCITY PROJECTILE<br>- Continue Hyper Velocity Projectile - Demonstrate the component technology required to support hypervelocity launch and common interfaces for powder gun and railgun launch conditions. | | | |
| ***Title:*** SEA STRIKE (STK) | 20.844 | 32.389 | 34.425 |
| ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE. The Sea Strike (STK) FNC pillar develops deliverable technologies that provide new capabilities in power projection and deterrence, precise and persistent offensive power, weapons, aircraft, and expeditionary warfare.<br><br>The FY 2013 to FY 2014 increase was due primarily to the initiation of STK-FY13-01, STK-FY13-03, STK-FY14-01 and STK-FY14-03, and the planned ramp-up of STK-FY13-04.<br><br>The FY 2014 to FY 2015 increase was due to the initiation of STK-FY15-01, STK-FY15-02 and STK-FY15-03.<br><br>***FY 2013 Accomplishments:***<br>EC: STK-FY08-04 Next Generation Airborne Electronic Attack<br>- Complete Next Generation Airborne Electronic Attack - Develop advanced broadband, high-power active arrays, digital and photonics based beamformers and ultra wide band digital techniques generators. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: STK-FY08-06 Increased Capability Against Moving and Stationary Targets<br>- Complete Direct Attack Seeker Head automatic target recognition algorithm development and low cost optics enhancements.<br><br>EC: STK-FY09-03 Enhanced Weapons Technologies<br>- Complete High Speed Components - Investigate radome manufacturing methodologies to improve product through-put.<br>- Continue Counter Air Defense Improvements - Investigate materials and design concepts, and develop high temperature resin-fiber and high temperature, oxidative-exhaust resistant materials with associated design implementations.<br><br>EC: STK-FY09-05 Advanced Threat Aircraft Countermeasures<br>- Complete Countermeasures for Advanced Imaging Infrared (I2R) - Develop final techniques and advanced component designs for countermeasures to advanced imaging infrared sensors.<br>- Complete Countermeasures for millimeter wave - Bench test decoy power supply and power amplifier modules.<br><br>EC: STK-FY10-02 Multi-Target Track and Terminate (MTTT)<br>- Continue Multi-Target Laser Designator (MTLD) - Develop, fabricate and test advanced optical techniques to enable multiple simultaneous target designations in order to defeat multiple targets (e.g., Swarm attacks).<br><br>EC: STK-FY11-01 Strike Accelerator<br>- Continue Strike Accelerator - Develop and understand advanced airborne capability to accurately identify targets using Advanced Target Recognition.<br><br>EC: STK-FY11-02 Radar Electronic Attack Protection (REAP)<br>- Continue Identification and Defeat of EA Systems (IDEAS) - Conduct Applied Research in support of algorithm development.<br>- Continue Network "Sentric" Electronic Protection (EP) - Develop software and algorithms for electronic protection solutions.<br><br>EC: STK-FY12-01 Submarine Survivability - Electronic Warfare<br>- Continue Coherent Electronic Attack for Submarines (CEAS) - Develop electronic attack waveforms and techniques to counter advanced coastal radars.<br><br>EC: STK-FY12-02 High Energy Spectrally Beam Combined (SBC) Fiber Laser System<br>- Continue High Energy Fiber Laser System - Investigate and understand high energy laser, beam control and other technologies to enable a high energy laser weapons system. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: STK-FY13-02 Hostile Fire (HF) Suppression<br>- Initiate Hostile Fire Suppression System - Develop efficient, low weight, multi-band HF suppression system components and fire detection (flash tracking) algorithms.<br><br>EC: STK-FY13-04 AIM-9X Enablers (AXE)<br>- Initiate SMOKE - Design and model an advanced rocket motor, warhead, and safe-arm device for the AIM-9X Sidewinder missile.<br><br>***FY 2014 Plans:***<br>EC: STK-FY09-03 ENHANCED WEAPONS TECHNOLOGIES<br>- Complete Counter Air Defense Improvements - Finish materials and design concepts, and develop high temperature resin-fiber and high temperature oxidative-exhaust resistant materials with associated design implementations.<br><br>EC: STK-FY10-02 MULTI-TARGET TRACK AND TERMINATE (MTTT)<br>- Complete Multi-Target Laser Designation (MTLD) - Design system components to fit the Fire Scout form factor and conduct laboratory testing.<br><br>EC: STK-FY11-01 STRIKE ACCELERATOR<br>- Continue Strike Accelerator - Develop and understand advanced airborne capability to accurately identify targets using Advanced Target Recognition.<br><br>EC: STK-FY11-02 RADAR ELECTRONIC ATTACK PROTECTION (REAP)<br>- Continue Identification and Defeat of Electronic Attack Systems (IDEAS) - Develop Electronic Support and Electronic Protection algorithms and techniques to counter hostile modern jammers.<br>- Continue Network "Sentric" Electronic Protection (EP) - Develop improved software and algorithms for electronic protection solutions.<br><br>EC: STK-FY12-01 SUBMARINE SURVIVABILITY - ELECTRONIC WARFARE.<br>- Continue Coherent Electronic Attack for Submarines (CEAS) - Update the Spiral 1 System Requirements, Architecture, Implementation and Fabrication from the assessments developed with 6.2 Applied Research, with the intention of Capability Demonstration and System Acceptance Testing in FY15.<br><br>EC: STK-FY12-02 HIGH ENERGY SPECTRAL BEAM COMBINED (SBC) FIBER LASER SYSTEM | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete High Energy Fiber Laser System - Investigate and understand high energy laser, beam control and other technologies to enable a high energy laser weapons system.<br><br>EC: STK-FY13-01 LONG RANGE RADIO FREQUENCY (RF) FIND, FIX AND ID<br>- Initiate Long Range Find, Fix and ID - Develop software and algorithms to enable long range Radio Frequency (RF) localization and identification from airborne radars.<br><br>EC: STK-FY13-02 HOSTILE FIRE (HF) SUPPRESSION<br>- Continue Hostile Fire Suppression System - Develop tracking techniques to point closed loop eye-safe laser.<br><br>EC: STK-FY13-03 ANTI-SURFACE WARFARE (ASUW) WEAPON UPGRADE<br>- Initiate Anti-Surface Warfare (ASuW) Weapon Upgrade - Begin subsystem design and development.<br><br>EC: STK-FY13-04 AIM-9X ENABLERS (AXE)<br>- Continue SMOKE - Design and model an advanced rocket motor, warhead, and safe-arm device for the AIM-9X Sidewinder missile.<br><br>EC: STK-FY14-01 PASSIVE SENSOR SURVEILLANCE (PASS)<br>- Initiate PAssive Sensor Surveillance (PASS) - Study and understand passive sensor phenomenology to enable its use for surveillance.<br><br>EC: STK-FY14-03 INTELLIGENT COLLABORATIVE ENGAGEMENT (ICE)<br>- Initiate Collaborative Electronic Attack (CEA) - Define Mission Objectives and System Architecture.<br>- Initiate Collaborative Anti-Surface Warfare Engagement (CASE) - Initiate design, development, and improvement of weapon-to-weapon communications, coupled with algorithms for limited weapon autonomy, to address the surface warfare mission area.<br>***FY 2015 Plans:***<br>EC: STK-FY11-01 STRIKE ACCELERATOR<br>- Complete Strike Accelerator - Develop and understand advanced airborne capability to accurately identify targets using Advanced Target Recognition.<br><br>EC: STK-FY11-02 RADAR ELECTRONIC ATTACK PROTECTION (REAP)<br>- Complete Identification and Defeat of EA Systems (IDEAS) - Develop innovative EW countermeasures that employ flexible and robust techniques against advanced Electronic Attack systems. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete Network "Sentric" Electronic Protection (EP) - Develop techniques for APG-79 electronic protection.<br><br>EC: STK-FY12-01 SUBMARINE SURVIVABILITY - ELECTRONIC WARFARE.<br>- Continue Coherent Electronic Attack for Submarines (CEAS) - Develop advanced Electronic Support and Electronic Attack techniques for detecting and countering advanced coastal surveillance RF threats.<br><br>EC: STK-FY13-01 LONG RANGE RF FIND, FIX AND ID<br>- Continue Long Range Find, Fix and ID - Develop algorithms for moving maritime RF identification.<br><br>EC: STK-FY13-02 HOSTILE FIRE (HF) SUPPRESSION<br>- Continue Hostile Fire Suppression System - Develop a robust muzzle flash tracking algorithm and begin the laser source design process.<br><br>EC: STK-FY13-03 ANTI-SURFACE WARFARE (ASUW) WEAPON UPGRADE<br>- Continue Anti-Surface Warfare (ASuW) Weapon Upgrade - Evaluate hardware and software.<br><br>EC: STK-FY13-04 AIM-9X ENABLERS (AXE)<br>- Continue SMOKE - Design and model an advanced rocket motor and subsystems device for the AIM-9X Sidewinder missile.<br><br>EC: STK-FY14-01 PASSIVE SENSOR SURVEILLANCE (PASS)<br>- Continue PAssive Sensor Surveillance (PASS) - Study and understand passive sensor phenomenology to enable its use for surveillance.<br><br>EC: STK-FY14-03 INTELLIGENT COLLABORATIVE ENGAGEMENT (ICE)<br>- Continue Collaborative Anti-Surface Warfare Engagement (CASE) - Design, develop, and improve weapon-to-weapon communications, coupled with algorithms for limited weapon autonomy, to address the surface warfare mission area.<br>- Continue Collaborative Electronic Attack (CEA) - Develop concepts and techniques that improve U.S. Naval forces ability to conduct Anti Surface Warfare.<br><br>EC: STK-FY15-01 SYNTHETIC APERTURE RADAR ELECTRONIC PROTECTION (SAREP)<br>- Initiate Synthetic Aperture Radar Electronic Protection - Develop algorithms and techniques to improve synthetic aperture radar electronic protection.<br><br>EC: STK-FY15-02 ROTOR-CRAFT ADVANCED PROTECTION FROM IR/EO/RPG (RAPIER) | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602750N / *(U)Future Naval Capabilities Applied Research* | **Project (Number/Name)**<br>0000 / *(U)Future Naval Capabilities Applied Research* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate Helicopter Active RPG Protection (HARP) - Design and develop prototype concepts and new processes for a Rocket Propelled Grenade (RPG) hard kill defense for rotorcraft.<br>- Initiate Multi-Spectral EO/IR Seeker Defeat - Develop and enhance existing test capability to include EO/IR hybrid hardware-in-the-loop for obscurant and jammer evaluation.<br><br>EC: STK-FY15-03 EXTENDED RANGE MODULAR UNDERSEA HEAVYWEIGHT VEHICLE (ER MUHV)<br>- Initiate MUHV Autonomy Suite - Define the autonomy framework.<br>- Initiate MUHV Sensors, Navigation and Guidance - Evaluate and downselect hardware. | | | |
| **Accomplishments/Planned Programs Subtotals** | 143.176 | 169.710 | 170.786 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

As discussed in Section A, there are a significant number of FNC technology products within this PE. In all cases, these technology products support the Department of the Navy FNC Program and are managed at the Office of Naval Research. All FNC investments in this PE are subjected to management oversight by 2-star chaired Integrated Product Teams (IPTs) that control the naval pillars of Sea Shield, Sea Strike, Sea Basing, Forcenet, Naval Expeditionary Maneuver Warfare, Enterprise and Platform Enablers, Power and Energy, Capable Manpower, and Force Health Protection. Each EC is aligned to a pillar and each technology product is aligned to an EC. At the lowest level, each technology product is measured against both technical and financial milestones on a monthly basis. Annually, each technology product is reviewed in depth for technical performance and development status by the Chief of Naval Research against goals that have been approved by the Navy's 3-star Technology Oversight Group (TOG). Also annually, each technology product is reviewed by its 2-star chaired pillar IPT for transition planning adequacy and transition commitment level. Products must meet TOG required transition commitment levels for S&T development to continue. Transition issues and required adjustments are reported annually by the Chief of Naval Research to the TOG, which establishes investment priorities for the FNC Program.

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | | | | | R-1 Program Element (Number/Name)<br>PE 0602782N *I Mine & Exp Warfare Applied Res* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 28.091 | 31.325 | 32.526 | - | 32.526 | 30.987 | 32.703 | 33.289 | 33.499 | Continuing | Continuing |
| 0000: *Mine & Exp Warfare Applied Res* | 0.000 | 28.091 | 31.325 | 32.526 | - | 32.526 | 30.987 | 32.703 | 33.289 | 33.499 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

FY 2013 funding associated with Future Naval Capability (FNC) efforts are transferring to a new Program Element titled Future Naval Capabilities Applied Research (PE 0602750N). This is to enhance the visibility of the FNC Program by providing an easily navigable overview of all 6.2 FNC investments in a single location.

**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 (Sep 2011). 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, RDT&E Budget Item Justification: PB 2015 Navy | | | | | Date: March 2014 |
|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research* | | | R-1 Program Element (Number/Name)<br>PE 0602782N *I Mine & Exp Warfare Applied Res* | | |
| **B. Program Change Summary ($ in Millions)** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO** | **FY 2015 Total** |
| Previous President's Budget | 32.394 | 31.326 | 31.702 | - | 31.702 |
| Current President's Budget | 28.091 | 31.325 | 32.526 | - | 32.526 |
| Total Adjustments | -4.303 | -0.001 | 0.824 | - | 0.824 |
| • Congressional General Reductions | - | -0.001 | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | -0.881 | - | | | |
| • SBIR/STTR Transfer | -0.703 | - | | | |
| • Program Adjustments | - | - | 0.915 | - | 0.915 |
| • Rate/Misc Adjustments | -0.001 | - | -0.091 | - | -0.091 |
| • Congressional General Reductions Adjustments | -2.718 | - | - | - | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 2 | R-1 Program Element (Number/Name)<br>PE 0602782N / *Mine & Exp Warfare Applied Res* | Project (Number/Name)<br>0000 / *Mine & Exp Warfare Applied Res* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000: *Mine & Exp Warfare Applied Res* | - | 28.091 | 31.325 | 32.526 | - | 32.526 | 30.987 | 32.703 | 33.289 | 33.499 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

Special Warfare/EOD R2 Activity includes the funding increase for the Joint Service Explosive Ordnance Disposal (JSEOD) effort.

**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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** MINE TECHNOLOGY | 0.585 | 0.981 | 0.961 |
| ***Description:*** 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.<br><br>***FY 2013 Accomplishments:***<br>- Continued assessment of sea mine technologies in order to maintain a level of expertise in naval mines.<br>- Continued development of concepts for semi-autonomous and remote controlled mines and minefields.<br>- Continued development of target discrimination technology for Target Detection Device (TDD).<br><br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Initiate analysis of intermediate and deep water minefield concepts.<br><br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above. | | | |
| ***Title:*** MINE/OBSTACLE DETECTION | 16.199 | 17.665 | 19.363 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602782N / *Mine & Exp Warfare Applied Res* | **Project (Number/Name)**<br>0000 / *Mine & Exp Warfare Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

***Description:*** 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).

Funding increase from FY 2013 to FY 2014 is due to the initiation of applied research in environmentally adaptive Automatic Target Recognition(ATR).

Funding increase from FY2014 to FY2015 for the Mine Obstacle Detection Area is due to plans to investigate several new and promising technology areas with respect to their applications to this mine reconnaissance. These efforts will examine feasibility of employing acoustic radiation forces or vibro-acoustography to generate new target discrimination feature sets. These investigative efforts include the audition based object formation and attention models for MCM. In addition applied research into sensor-generic architectures for multi-session minefield mapping with multiple UUVs will initiate along with research into model-based MCM sonar performance estimation.

***FY 2013 Accomplishments:***
- Continued development of automatic mine detection and classification algorithms for integrated forward-looking iPUMA sonar and sidelooking sonars.
- Continued development of UUV-based, extended range, electro-optic identification sensors and supporting meteorology and oceanography and planning systems.
- Continued integration of iPUMA and SAS systems in a single vehicle to obtain 100% area coverage.
- Continued to 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.
- Continued development of a Mine/Obstacle Detection and Avoidance capability for Autonomous Underwater Vehicles (AUVs) equipped with the iPUMA sonar system.
- Continued development of a small ultrasound acoustic underwater camera for UUV-based classification and identification of underwater mines.
- Continued development of drifting mine detection concepts.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602782N / *Mine & Exp Warfare Applied Res* | **Project (Number/Name)**<br>0000 / *Mine & Exp Warfare Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of heat engine for unmanned underwater vehicles powered by thermal gradients in the water column.<br>- Continued modeling of data fusion and mine contact handling.<br>- Continued research to demonstrate new structural-acoustic-based mine identification algorithms that do not require extensive training data to work in new underwater environments.<br>- Continued research to extend electro-optical imaging resolution in underwater environments by using short exposure techniques.<br>-Continued 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.<br>- Continued 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.<br>- Continued development of Long Range Low Frequency Broadband (LRLFBB) Sonar to significantly increase the minehunting area coverage rate.<br>- Continued 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.<br>- Continued Phase 2 of Advanced Mission Module Technology Development.<br>- Continued performance evaluation of physical layer signal processing algorithms and signaling schemes developed for underwater acoustic communication networks.<br>- Continued development of technologies for detection of mines and obstacles in riverine environments.<br>- Continued development of mine burial prediction models which include migrating sandwaves.<br>- Continued development of prediction models for surf zone optical properties.<br>- Continued 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.<br>- Continued development of system concepts for wide area detection of surface and submerged drifting mines.<br>- Continued effort to demonstrate proof-of-concept for a new standoff technology for helicopters that can detect buried mines in the surf-zone and on the beach.<br>- Continued effort to design and build advanced navigational capabilities for a fin propelled UUV in near-shore, turbid, obstacle cluttered environment.<br>- Continued effort to apply adaptive optics underwater to mitigate imaging distortion from optical turbulence and scattering.<br>- Completed investigation and development of signal processing algorithms in areas of research such as environmentally adaptive channel estimation/equalization, multi-carrier modulations 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.<br>- Completed development of new waveforms and algorithms for improved automatic discrimination of mines from non-traditional clutter. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602782N / *Mine & Exp Warfare Applied Res* | **Project (Number/Name)**<br>0000 / *Mine & Exp Warfare Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiated investigation into associated phenomenology and development of sensing technologies for mine and obstacle detection, classification and localization.<br><br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013 less those noted as completed above.<br>- Complete effort to demonstrate proof-of-concept for a new standoff technology for helicopters that can detect buried mines in the surf-zone and onto the beach.<br>- Complete effort to apply adaptive optics underwater to mitigate imaging distortion from optical turbulence and scattering.<br>- Initiate applied research in environmentally adaptive Automatic Target Recognition (ATR).<br>- Initiate development of in situ sensors to groundtruth overhead tactical sensors.<br><br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Complete effort to design and build advanced navigational capabilities for a fin propelled UUV in near-shore, turbid, obstacle cluttered environment.<br>- Initiate applied research in interactive sensing for MCM. | | | |
| ***Title:*** MINE/OBSTACLE NEUTRALIZATION<br><br>***Description:*** 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.<br><br>***FY 2013 Accomplishments:***<br>- Continued development of system concepts for autonomous neutralization of surface and submerged drifting mines.<br>- Completed development of concepts for sweeping and/or jamming of advanced mine threats.<br>- Completed concept development for neutralization of war surface drifiting mines.<br><br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013, less those noted as completed above.<br><br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Initiate investigation of techniques for neutralization of buried mines.<br>- Initiate investigation of techniques for emulation sweep. | 0.716 | 0.795 | 0.438 |
| ***Title:*** SPECIAL WARFARE/EOD | 10.591 | 11.884 | 11.764 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602782N / *Mine & Exp Warfare Applied Res* | **Project (Number/Name)**<br>0000 / *Mine & Exp Warfare Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

***Description:*** 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 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.

Funding increase from FY 2013 to FY 2014 due to the initiation of the development of technologies to reduce platform vulnerability.

***FY 2013 Accomplishments:***
- Continued development of AUV technologies for autonomous inspection of ship hulls.
- Continued development of technologies for contaminated water diving.
- Continued development of technologies for enhanced navigation and Intelligence, Surveillance and Reconnaissance (ISR) in riverine environments.
- Continued development of technologies to detect and locate IEDs.
- Continued development of technologies to access IEDs.
- Continued development of technologies to diagnose and identify underwater munitions.
- Continued development of technologies to identify and diagnose components and characteristics of Improvised Explosive Devices.
- Continued development of technologies to detect and locate buried munitions.
- Continued effort to support Joint Service Explosive Ordnance Disposal (JSEOD) applied research.
- Completed development of maritime Tagging, Tracking, and Locating (TTL) technologies.
- Completed effort to demonstrate the operation of a short-range underwater sensor network operating in a riverine environment for several months.
- Initiated development of an air-delivery method of small/tactical UUVs to extend sensor operational range and expedite ingress.

***FY 2014 Plans:***
- Continue all efforts of FY 2013, less those noted as completed above.
- Initiate development of technologies to neatralize energetic materials from a safe standoff using small EOD robots.
- Initiate development of technologies to excavate buried IEDs from a small EOD robot.
- Initiate development of technologies to demonstrate an autonomous dual manipulator robot for complex underwater EOD missions.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 2 | **R-1 Program Element (Number/Name)**<br>PE 0602782N / *Mine & Exp Warfare Applied Res* | **Project (Number/Name)**<br>0000 / *Mine & Exp Warfare Applied Res* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate development of technologies to enhance diver situational awareness.<br>- Initiate development of technologies to reduce platform vulnerability.<br>- Initiate investigation of multi-modal signature reduction technologies for wet/dry-submersibles and semi-submersibles.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Complete development of an air-delivery method of small/tactical UUVs to extend sensor operational range and expedite ingress.<br>- Complete development of technologies to detect trace and bulk explosive materials from a safe position manually.<br>- Complete development of technologies for prospective tele-autonomy features in EOD robotic platforms command and control.<br>- Initiate development of technologies to dispose of ordnance with insensitive munitions from a safe standoff position manually or using smal lEOD robots.<br>- Initiate development of technologies to diagnose buried ordnance in situ from a safe standoff position manually or using small EOD robots. | | | |
| **Accomplishments/Planned Programs Subtotals** | 28.091 | 31.325 | 32.526 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**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, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | | | | | R-1 Program Element (Number/Name)<br>PE 0603114N *I Power Projection Advanced Technology* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 51.739 | 48.201 | 37.734 | - | 37.734 | 44.408 | 27.293 | 12.433 | 12.486 | Continuing | Continuing |
| 2911: *Power Proj Adv Tech* | 0.000 | 51.739 | 48.201 | 37.734 | - | 37.734 | 44.408 | 27.293 | 12.433 | 12.486 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 (Sep 2011). 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 Electromagnetic (EM) Rail Gun for naval weapon systems.

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

| B. Program Change Summary ($ in Millions) | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 56.543 | 48.201 | 31.327 | - | 31.327 |
| Current President's Budget | 51.739 | 48.201 | 37.734 | - | 37.734 |
| Total Adjustments | -4.804 | - | 6.407 | - | 6.407 |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | 2.172 | - | | | |
| • SBIR/STTR Transfer | -1.651 | - | | | |
| • Program Adjustments | - | - | 6.407 | - | 6.407 |
| • Rate/Misc Adjustments | 0.001 | - | - | - | - |
| • Congressional General Reductions Adjustments | -5.326 | - | - | - | - |

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | **R-1 Program Element (Number/Name)**<br>PE 0603114N *I Power Projection Advanced Technology* |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | R-1 Program Element (Number/Name)<br>PE 0603114N / *Power Projection Advanced Technology* | Project (Number/Name)<br>2911 / *Power Proj Adv Tech* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2911: *Power Proj Adv Tech* | - | 51.739 | 48.201 | 37.734 | - | 37.734 | 44.408 | 27.293 | 12.433 | 12.486 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 that 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. The Navy is furthering the development of solid state, high energy laser technology for use as a weapon system on future surface ships.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** PRECISION STRIKE TECHNOLOGY | 51.739 | 48.201 | 37.734 |

***Description:*** 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.

FY13 to FY 2014 reduction is due to the Solid State Laser (SSL) program completing efforts in 0603114N. Solid State Laser program funding continues in PE 0602114N for FY 2015.

The SSL-QRC program was initiated during FY13 and is planned to complete during FY 2015. The reduction of funding from FY 2014 to FY 2015 is due to the completion of procurement and design activities during FY 2014.

***FY 2013 Accomplishments:***

Electromagnetic (EM) Railgun:
-Continued development and testing of projectile component concepts at 32 MJ muzzle energy tests.
-Continued ship integration study efforts.
-Continued next generation industry repetitive rate launcher development and test planning.
-Continued generation repetitive rate pulsed power fabrication in support of future repetitive rate launcher testing.
-Completed next generation industry rep rate launcher conceptual/feasibility design.
-Initiated fabrication of rep rate lab launcher for testing of barrel life components.
-Initiated next generation industry rep rate launcher preliminary design.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603114N / *Power Projection Advanced Technology* | **Project (Number/Name)**<br>2911 / *Power Proj Adv Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| -Initiated component fabrication and testing of repetitive firing rate barrel life with EM lab launcher at tactically relevant muzzle energy.<br><br>Weapons System Improvement:<br>-Continued kill-chain studies to identify and recommend engineering trades to enable weapon system interoperability and data fusion alternatives. These studies will assess engineering feasibility of various kill-chain options and assess the capability provided.<br><br>Solid State Laser Technology Quick Reaction Capability (SSL-QRC):<br>- Initiated development of the Solid State Laser Quick Response Capability (SSL-QRC) to upgrade the NAVSEA developed Laser Weapons System (LaWS) that will support an extended deployment on a Naval Surface combatant in the Persian Gulf during FY 2014.<br><br>Solid State Laser Technology Maturation Program (SSL-TM):<br>-Initiated development of a maritime laser weapons system through competitive procurement. Initiate Laser System engineering integration trade studies and design with contractor developed designs. This system will be capable of supporting missions such as small boat, UAV, and ISR disruption and defeat. This work included scientific and engineering trade studies to support integration and test of an advanced development system. This system will include a maritime beam director and high power, solid state laser (SSL) that is capable of tracking and engaging a surface or airborne target at a suitable stand-off distance in the maritime environment and includes efforts to measure atmospheric absorption and turbulence.<br>-Continued development of the Hybrid Predictive Avoidance Safety System (HPASS) to deconflict laser system operations with friendly sensor and platforms. | | | |
| ***FY 2014 Plans:***<br>Electromagnetic (EM) Railgun:<br>-Continue all efforts of FY 2013 unless completed above.<br><br>Weapons System Improvement:<br>-Continue all efforts of FY 2013 unless completed above.<br><br>Solid State Laser Technology Quick Reaction Capability (SSL-QRC):<br>-Complete development of the Solid State Laser Quick Response Capability (SSL-QRC) to upgrade the NAVSEA developed Laser Weapons System (LaWS). | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603114N / *Power Projection Advanced Technology* | **Project (Number/Name)**<br>2911 / *Power Proj Adv Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| -Complete integration and installation of LaWS on a Naval Surface combatant to support an extended demonstration in the Persian Gulf that will conclude during FY 2015.<br><br>Solid State Laser Technology Maturation Program (SSL-TM):<br>-Continue all efforts of FY 2013 unless completed above.<br>***FY 2015 Plans:***<br>Electromagnetic (EM) Railgun:<br>-Continue all efforts of FY 2014 unless completed above.<br><br>Weapons System Improvement:<br>-Continue all efforts of FY 2014 unless completed above.<br><br>Solid State Laser Technology Quick Reaction Capability (SSL-QRC):<br>-Complete LaWS demonstration on a Naval Surface combatant in the Persian Gulf and remove LaWS equipment.<br><br>Solid State Laser Technology Maturation Program (SSL-TM):<br>-Complete Laser System engineering integration trade studies and design and begin integration of contractor developed designs.<br>-Initiate land based testing of system and system components.<br>-Continue development of the Hybrid Predictive Avoidance Safety System (HPASS) to deconflict laser system operations with friendly sensors and platforms. | | | |
| **Accomplishments/Planned Programs Subtotals** | 51.739 | 48.201 | 37.734 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

The metrics used are programmatic milestones and technical milestones, such as completion of technical trade studies examining suitable technologies for subsequent prototype development; incremental laboratory and field testing of components and sub-systems; and delivery of industry-developed prototypes for demonstration.

THIS PAGE INTENTIONALLY LEFT BLANK

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | | | | | R-1 Program Element (Number/Name)<br>PE 0603123N *I Force Protection Advanced Technology* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 16.273 | 28.286 | 25.831 | - | 25.831 | 34.938 | 35.540 | 23.392 | 16.921 | Continuing | Continuing |
| 2912: *Force Protection Advanced Technology* | 0.000 | 14.097 | 25.721 | 23.207 | - | 23.207 | 32.265 | 32.815 | 20.618 | 14.147 | Continuing | Continuing |
| 3049: *Force Protection* | 0.000 | 2.176 | 2.565 | 2.624 | - | 2.624 | 2.673 | 2.725 | 2.774 | 2.774 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

FY 2013 funding associated with Future Naval Capability (FNC) efforts are transferring to a new Program Element titled Future Naval Capabilities Advanced Technology Development (PE 0603673N). This is to enhance the visibility of the FNC Program by providing an easily navigable overview of all 6.3 FNC investments in a single location.

**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 (Sep 2011). 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.

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, RDT&E Budget Item Justification: PB 2015 Navy | | | | | Date: March 2014 |
|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | | | R-1 Program Element (Number/Name)<br>PE 0603123N *I Force Protection Advanced Technology* | | |
| **B. Program Change Summary ($ in Millions)** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO** | **FY 2015 Total** |
| Previous President's Budget | 18.616 | 28.328 | 32.354 | - | 32.354 |
| Current President's Budget | 16.273 | 28.286 | 25.831 | - | 25.831 |
| Total Adjustments | -2.343 | -0.042 | -6.523 | - | -6.523 |
| • Congressional General Reductions | - | -0.042 | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | -0.262 | - | | | |
| • SBIR/STTR Transfer | -0.521 | - | | | |
| • Program Adjustments | - | - | -6.523 | - | -6.523 |
| • Rate/Misc Adjustments | 0.001 | - | - | - | - |
| • Congressional General Reductions Adjustments | -1.561 | - | - | - | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | R-1 Program Element (Number/Name)<br>PE 0603123N / *Force Protection Advanced Technology* | Project (Number/Name)<br>2912 / *Force Protection Advanced Technology* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2912: *Force Protection Advanced Technology* | - | 14.097 | 25.721 | 23.207 | - | 23.207 | 32.265 | 32.815 | 20.618 | 14.147 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** SURFACE SHIP & SUBMARINE HULL MECHANICAL & ELECTRICAL (HM&E) | 6.004 | 6.821 | 8.656 |

***Description:*** Activity includes: advanced technology demonstrations to evaluate emerging energy technologies and advanced technology development for Unmanned Sea Surface Vehicles.
The funding increase from FY 2014 to FY 2015 is due the ramping up of the Energy Systems Technology Evaluation Program (E-STEP) effort.

***FY 2013 Accomplishments:***
- Continued development of autonomous navigation for Unmanned Sea Surface Vehicles from a host ship
- Continued development of Integrated Damage Control Systems which includes Integrated Damage Control Communications and Advanced Magazine Protection System.
- Continued Total Ship Survivability Damage Tolerance and Recoverability efforts which include integrated damage control situation awareness technologies.
- Continued 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.
- Continued Underwater Total Ship Survivability/Payload Implosion and Platform Damage Avoidance efforts.
- Continued scaled testing and large scale analysis for ship protection systems.
- Continued fabrication of scaled control surface actuator systems.
- Continued air-independent energy system sub-scale component development, analysis, and benchtop testing.
- Continued efforts to conduct advanced technology demonstrations to evaluate emerging energy technologies using Navy and Marine Corps facilities as test beds.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603123N / *Force Protection Advanced Technology* | **Project (Number/Name)**<br>2912 / *Force Protection Advanced Technology* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiated efforts to conduct advanced technology demonstrations to evaluate emerging energy technologies using Navy and Marine Corps facilities as test beds.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014. | | | |
| ***Title:*** AIRCRAFT TECHNOLOGY | 8.093 | 18.900 | 14.551 |
| ***Description:*** DESCRIPTION:<br>The Aircraft Technology activity develops technologies for enhanced capability of Naval aviation aircraft platforms in terms of mission effectiveness, platform range, responsiveness, survivability, observability, readiness, safety and life cycle cost. It also develops new Naval air vehicle concepts and high impact, scalable Naval air vehicle technologies, such as - autonomous air vehicle command and control, helicopter and tiltrotor rotor drive systems, aerodynamics, propulsion systems, materials, structures and flight controls for future and legacy air vehicles. This activity directly supports the Naval Aviation Enterprise Science and Technology Objectives and the Naval Science and Technology Strategic Plan, principally in the Autonomy and Unmanned Systems, Platform Design and Survivability, Power and Energy and Total Ownership Cost Focus Areas.<br><br>The funding increase in FY 2013 and ramp up in FY 2014 are due to the Autonomus Areial Cargo/Utility System (AACUS) program and the 6.3 portion of the Variable Cycle Advance Technology (VCAT) program.<br><br>The funding decrease in FY 2015 is due to a re-scoping of the 6.3 portion of the Variable Cycle Advanced Technology (VCAT) program.<br><br>***FY 2013 Accomplishments:***<br>- Initiated demonstration of initial core software, sensor, air vehicle, and capability applications for Autonomous Aerial Cargo/Utility System (AACUS).<br>- Initiated the advanced technology demonstration portion of the Variable Cycle Advanced Technology (VCAT) Program. Critical technology development efforts will begin with major engine manufactures and system contractors to develop/mature the highest priority, long-lead propulsion system technologies, including variable/adaptive cycle engine components, for next generation carrier-based TACAIR/ISR systems.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603123N / *Force Protection Advanced Technology* | **Project (Number/Name)**<br>2912 / *Force Protection Advanced Technology* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Demonstrate initial core software, sensor, air vehicle, and capability applications for Autonomous Aerial Cargo/Utility System (AACUS).<br>- Complete the majority of VCAT Phase I variable cycle engine/propulsion subsystem technology development efforts.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Continue VCAT Phase I variable cycle engine/propulsion subsystem technology development efforts through completion. | | | |
| **Accomplishments/Planned Programs Subtotals** | 14.097 | 25.721 | 23.207 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**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:
- Advanced technology demonstrations to evaluate emerging energy technologies.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | R-1 Program Element (Number/Name)<br>PE 0603123N / *Force Protection Advanced Technology* | Project (Number/Name)<br>3049 / *Force Protection* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3049: *Force Protection* | - | 2.176 | 2.565 | 2.624 | - | 2.624 | 2.673 | 2.725 | 2.774 | 2.774 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

Develop advanced technologies, critical to protecting naval installations, to 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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** EMERGING THREATS | 2.176 | 2.565 | 2.624 |

***Description:*** This activity includes development of advanced technologies critical to protecting naval installations, and 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 2013 Accomplishments:***

- Continued development of lower cost/higher performance Force Protection sensors and automated detection algorithms, and decision support tools.
- Continued research to reduce force protection manpower and equipment costs through automation and predictive learning algorithms.
- Continued threat characterization research and perception experiments for sensor performance optimization and model development and validation.
- Continued development of all weather sensors optimized for installation of force protection.
- Continued research into sensors for use in counter-surveillance around protected facilities.
- Continued research to advance sensor fusion capabilities in high density networks with diverse sensor grids.
- Continued development of assessment algorithms and information analysis technologies to augment skills or replace persons in operations centers.
- Continued research into sensors and countermeasures for use against unmanned underwater vehicles.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603123N / *Force Protection Advanced Technology* | **Project (Number/Name)**<br>3049 / *Force Protection* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued multi-band electro-optical sensor and fusion algorithm development and demonstrations in adverse weather conditions.<br>- Conducted interim demonstration of acoustic sensors for perimeter and area surveillance in realistic environments.<br>- Initiated multi-band electro-optical sensor and fusion algorithm development and demonstrations in adverse weather conditions.<br>- Initiated development of protection technology for naval installation power and energy infrastructure.<br>- Expanded research into sensors and countermeasures for use against unmanned underwater to include surface swimmers, underwater divers, and underwater diver propulsion aids.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013, less those completed.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014.<br>- Continue demonstration of multi-band electro-optical sensors and fusion algorithms in adverse weather conditions.<br>- Initiate demonstration of sensors and countermeasures for use against underwater to include surface swimmers, underwater divers, diver propulsion aids, and underwater unmanned vehicles.<br>- Initiate research in non-acoustic detection, tracking, classification, and engagement of underwater threats to naval installations.<br>- Initiate development of autonomous unmanned harbor defense systems for perimeter patrol and threat interdiction. | | | |
| **Accomplishments/Planned Programs Subtotals** | 2.176 | 2.565 | 2.624 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

The overall goals of this advanced technology program are the development of technologies which will provide seamless full spectrum protection against asymmetric terrorist attack by improving the ability to protect naval installations. Overall metric goals are to reduce the required manpower and skill levels devoted to the force protection mission. Specific metric under the Project includes: 50% reduction of manpower associated with FP surveillance, situational awareness, and decision making, 2x improvement in electro-optical sensor performance in adverse weather conditions, 50%reduction in sensor cost per square or cubic meter of detection at a given resolution, and a 50% reduction in false alarm rates for automated detection and tracking algorithms both above and below water.

THIS PAGE INTENTIONALLY LEFT BLANK

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | | | | | R-1 Program Element (Number/Name)<br>PE 0603271N *I Electromagnetic Systems Advanced Technology* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 60.098 | 56.179 | 64.623 | - | 64.623 | 24.911 | 20.576 | 14.289 | 13.212 | Continuing | Continuing |
| 2913: *Electromagnetic Systems Advanced Technology* | 0.000 | 51.848 | 56.179 | 64.623 | - | 64.623 | 24.911 | 20.576 | 14.289 | 13.212 | Continuing | Continuing |
| 9999: *Congressional Adds* | 0.000 | 8.250 | - | - | - | - | - | - | - | - | - | 8.250 |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

FY 2013 funding and associated Future Naval Capability (FNC) efforts addressed in this Program Element (PE) are transferring to a new PE titled Future Naval Capabilities Advanced Technology Development (PE 0603673N). This is to enhance the visibility of the FNC Program by providing an easily navigable and consolidated overview of all 6.3 FNC investments in a single PE.

**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 (Sep 2011). 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, Multi-Function sensor systems, and Position, Navigation and Timing (PNT) capabilities. 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, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | **R-1 Program Element (Number/Name)**<br>PE 0603271N *I Electromagnetic Systems Advanced Technology* |

| B. Program Change Summary ($ in Millions) | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 54.858 | 56.179 | 71.268 | - | 71.268 |
| Current President's Budget | 60.098 | 56.179 | 64.623 | - | 64.623 |
| Total Adjustments | 5.240 | - | -6.645 | - | -6.645 |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | 1.631 | - | | | |
| • SBIR/STTR Transfer | -0.681 | - | | | |
| • Program Adjustments | - | - | -6.645 | - | -6.645 |
| • Rate/Misc Adjustments | -0.001 | - | - | - | - |
| • Congressional General Reductions Adjustments | -4.709 | - | - | - | - |
| • Congressional Add Adjustments | 9.000 | - | - | - | - |

| Congressional Add Details ($ in Millions, and Includes General Reductions) | FY 2013 | FY 2014 |
|---|---|---|
| **Project:** 9999: *Congressional Adds* | | |
| Congressional Add: *Adv Radar Innovation Fund - S&T (Cong)* | 8.250 | - |
| Congressional Add Subtotals for Project: 9999 | 8.250 | - |
| Congressional Add Totals for all Projects | 8.250 | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | R-1 Program Element (Number/Name)<br>PE 0603271N / *Electromagnetic Systems Advanced Technology* | Project (Number/Name)<br>2913 / *Electromagnetic Systems Advanced Technology* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2913: *Electromagnetic Systems Advanced Technology* | - | 51.848 | 56.179 | 64.623 | - | 64.623 | 24.911 | 20.576 | 14.289 | 13.212 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

Work in this project addresses cost-effective RF technology for Surface and Aerospace Surveillance sensors and systems, EW sensors and systems, RF Communication Systems, Multi-Function sensor systems, and Position, Navigation and Timing (PNT) capabilities.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** ELECTRONIC AND ELECTROMAGNETIC SYSTEMS | 1.496 | 4.227 | 3.259 |

***Description:*** 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.

a) Electronic Warfare (EW) Roadmap - Develop classified advanced electronic warfare technology in support of current and predicted capability requirements.
b) Integrated Topside (InTop): Develop wide-band array and electronic systems to support EW capability and other functions, including but not limited to IO and LOS Comms, for surface combatants with potential application to other platforms.

The increase from FY 2013 to FY 2014 is due to funds provided only in FY 2014 to accelerate the development of Integrated Topside (InTop) efforts.

The decrease from FY 2014 to FY 2015 is due to funds provided only in FY 2014 to accelerate the development of Integrated Topside (InTop) efforts were not available in FY2015.

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

***FY 2013 Accomplishments:***
FY 2013 Accomplishments:
Electronic Warfare (EW) Roadmap:

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603271N / *Electromagnetic Systems Advanced Technology* | **Project (Number/Name)**<br>2913 / *Electromagnetic Systems Advanced Technology* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of classified advanced electronic warfare technology in support of current and predicted capability requirements.<br><br>***FY 2014 Plans:***<br>Electronic Warfare (EW) Roadmap:<br>- Continue all efforts of FY 2013 less those noted as completed.<br><br>Integrated Topside (InTop):<br>- Initiate and complete development of GENSER IO Surrogate<br>- Initiate and complete integration of IO Surrogate with Integrated Topside (InTop)<br><br>***FY 2015 Plans:***<br>Electronic Warfare (EW) Roadmap:<br>- Continue all efforts of FY 2014 less those noted as completed. | | | |
| ***Title:*** GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY | 4.075 | 2.263 | 2.307 |
| ***Description:*** 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).<br><br>The major objectives of this activity are:<br>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.<br>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.<br>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. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603271N / *Electromagnetic Systems Advanced Technology* | **Project (Number/Name)**<br>2913 / *Electromagnetic Systems Advanced Technology* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

The decrease in funding from FY 2013 to FY 2014 is due to the reduced investment in Advanced Technology efforts for GPS and Navigation, and planned increase in Applied Research investment in the Navigation Technology activity in PE 0602271N.

The following are non-inclusive examples for projects funded in this activity.

***FY 2013 Accomplishments:***

GPS Anti-Jam Antennas and Receivers:
- Continued development of Small Antenna Based Anti-spoofing project.
- Continued development of Advanced Spoofer Tracking.
- Continued development of Next Generation Global Positioning Satellite System - Situational Awareness (XGPSS-SA) Challenged Environment.
- Continued Modernized Receiver for RF Challenged Environments.
- Continued development of the Simulation of GPS Signals in a Stressed Environment.
- Continued development of Self Calibrating GPS AJ Antennas for Electronic Support.
- Continued and completed Accurate Cooperative Geolocation System.
- Initiated Application of National Airspace Air Traffic Control (ATC) Automatic Dependant Surveillance Broadcast (ADS-B) project.
- Initiated Cognitive Modernized GPS User Equipment (MGUE) for GPS-Denied Environments project.

Precision Time and Time Transfer:
- Continued 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 development and Distributing Time-frequency Device.
- Continued development of Rb 3-cc Tactical Grade Atomic Clock (TGAC).
- Initiated Ultra-Precise Timing Using GPS (UPTUG) Project.

Non-GPS Navigation Technology:
- Continued Optically Transduced MEMS Inertial Navigation System project.
- Continued Sub-harmonic Lateral Mode MEMS Inertial Navigation System project.
- Continued Two-Axis Gyro-compass Fiber Optic Inertial Navigation System project.
- Continued development of Wavewinds project.
- Continued development of Small Unmanned Underwater Vehicle - Sonar Aided Inertial Navigation Technology (UUV-SAINT) project.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603271N / *Electromagnetic Systems Advanced Technology* | **Project (Number/Name)**<br>2913 / *Electromagnetic Systems Advanced Technology* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of Portable PCNS project.<br>- Continued development of Superconducting Magnetometer On-Board Navigation (SIMON) System.<br>- Continued development of Alternative Navigation Over Unstructured or Featureless Terrain.<br>- Completed development of a small, lightweight Micro-Electro-Mechanical Systems (MEMS) Accelerometer for navigation systems; and fabricated an Electro-Optic Accelerometer. | | | |
| ***FY 2014 Plans:***<br>GPS Anti-Jam Antennas and Receivers:<br>- Continue all efforts of FY 2013 less those noted as completed.<br>- Complete Application of National Airspace Air Traffic Control (ATC) Automatic Dependant Surveillance Broadcast (ADS-B) project.<br>- Initiate GPS Antenna System for Enhanced EP, ES and Precise Navigation.<br><br>Precision Time and Time Transfer:<br>- Continue all efforts of FY 2013 less those noted as completed.<br>- Complete Ultra-Precise Timing Using GPS (UPTUG) Project.<br>- Initiate DoD master clock time transfer via optical fibers.<br><br>Non-GPS Navigation Technology:<br>- Continue all efforts of FY 2013 less those noted as completed.<br>- Complete Modernized Integrated Spoofer Tracking (MIST) Prototype.<br>- Complete Hollow-core Fiber Optic Inertial Navigation System.<br>- Initiate Two-Axis Fiber Optic Inertial Navigation System Phase II project.<br>- Initiate Mechanical System (MEMS) Inertial Navigation System (INS) Phase II project.<br>- Initiate Angle-Only Infra Red Celestial Navigation System. | | | |
| ***FY 2015 Plans:***<br>GPS Anti-Jam Antennas and Receivers:<br>- Continue all efforts of FY 2014 less those noted as completed.<br><br>Precision Time and Time Transfer:<br>- Continue all efforts of FY 2014 less those noted as completed.<br>- Initiate Tactical Grade Atomic Clock.<br><br>Non-GPS Navigation Technology: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603271N / *Electromagnetic Systems Advanced Technology* | **Project (Number/Name)**<br>2913 / *Electromagnetic Systems Advanced Technology* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts of FY 2014 less those noted as completed.<br>- Initiate Miniature Ultra-Cold Atom Chip Inertial Sensors.<br>- Complete Precise At-Sea Ship's Indoor Outdoor Navigation (PASSION). | | | |
| ***Title:*** INTEGRATED TOPSIDE (INTOP) INNOVATIVE NAVAL PROTOTYPE (INP) | 46.277 | 49.689 | 49.907 |
| ***Description:*** The overarching objective of the INTOP INP is to develop and demonstrate a set of prototypes that integrate RF functionality (EW, Radar, Communications, Navigation) into a common set of multi-function apertures electronics and software 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 which can together perform any of the above functions.<br><br>The major objectives of this activity are:<br><br>a) Submarine SATCOM Array - Develop wide-band SATCOM array capable of supporting EW for submarines.<br><br>b) Electronic Warfare (EW)/Information Operations (IO)/Line of Sight (LOS) Communications (Comms) for Surface Combatants - Develop wide-band array to support EW capability and other functions, including but not limited to IO and LOS Comms, for surface combatants with potential application to other platforms.<br><br>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.<br><br>d) Surface Combatant Communication Array - Develop wide-band surface combatant communication array capable of supporting other RF functions.<br><br>e) Resource Allocation Manager - Develop enterprise common Resource Allocation Manager.<br><br>f) Digital Radar - Develop an all digital radar to demonstrate advanced concepts for coherent radar networking and control, which will increase radar coverage and provide new levels of electronic protection (EP), while maximizing radar resources and reducing cost.<br><br>g) Low Band Communications, IO and EW - Develop low band technology development and concept studies leading to development of an Advanced Development Model (ADM). | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603271N / *Electromagnetic Systems Advanced Technology* | **Project (Number/Name)**<br>2913 / *Electromagnetic Systems Advanced Technology* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| The increase in funding from FY2014 to FY2015 is to design and develop the LowRIDR to cover the bands below SEWIP Block III, to build the highly adaptable FLEXDAR Radar.<br><br>The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.<br><br>***FY 2013 Accomplishments:***<br>Submarine SATCOM Array:<br>- Continued development of prototype build.<br>- Continued integration and test program.<br><br>EW/IO/Comms for Surface Combatants:<br>- Continued development of prototype capability.<br>- Continued development of the EW/IO/COMMS prototype.<br>- Initiated demonstration of technologies and subsystems for EW/IO/Comms prototype.<br><br>Architecture, Standards and Devices:<br>- Continued development of deckhouse and platform integration strategies and concepts.<br>- Continued SEWIP Block III Prototype, a multi-function RF topside aperture prototype covering approximately 200MHz to 22 GHz and providing 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.<br>- Completed development of architecture and interfaces and their application to wide-band SATCOM arrays for submarines.<br><br>Surface Combatant Satellite Communications Array:<br>- Continued design effort.<br><br>Resource Allocation Manager:<br>- Completed development of RAM software and infrastructure.<br>- Initiated integration and test of RAM.<br><br>Digital Radar: | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603271N / *Electromagnetic Systems Advanced Technology* | **Project (Number/Name)**<br>2913 / *Electromagnetic Systems Advanced Technology* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued design effort.<br><br>Low Band Communications, IO and EW: Low Band Communications, IO and EW:<br>- Initiate development of the initial architecture and requirements.<br><br>***FY 2014 Plans:***<br>Submarine SATCOM Array:<br>- Continue all efforts of FY 2013 less those noted as complete above.<br>- Complete prototype build.<br><br>EW/IO/Comms for Surface Combatants:<br>- Continue all efforts of FY 2013 less those noted as complete above.<br>- Complete development of EW/IO/Comms prototype.<br>- Complete demonstration of technologies and subsystems for EW/IO/Comms prototype.<br>- Initiate integration and test of ADM.<br><br>Architecture, Standards and Devices:<br>- Continue all efforts of FY 2013 less those noted as complete above.<br>- Complete SEWIP Block III Prototype<br><br>Surface Combatants Satellite Communications Array:<br>- Continue all efforts of FY 2013 less those noted as complete above.<br><br>Resource Allocation Manager:<br>- Continue all efforts of FY 2013 less those noted as complete above.<br><br>Digital Radar:<br>- Continue all efforts of FY 2013 less those noted as complete above.<br>- Initiate system build for back-end.<br>- Initiate system design for front-end.<br><br>Low Band Communications, IO and EW:<br>- Continue all efforts of FY 2013 less those noted as complete above.<br>***FY 2015 Plans:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603271N / *Electromagnetic Systems Advanced Technology* | **Project (Number/Name)**<br>2913 / *Electromagnetic Systems Advanced Technology* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Submarine SATCOM Array:<br>- Continue all efforts of FY 2014 less those noted as complete above.<br>- Complete integration and test.<br><br>EW/IO/Comms for Surface Combatants:<br>- Continue all efforts of FY 2014 less those noted as complete above.<br>- Complete integration and test of ADM.<br><br>Architecture, Standards and Devices:<br>- Continue all efforts of FY 2014 less those noted as complete above.<br><br>Surface Combatants Satellite Communications Array:<br>- Continue all efforts of FY 2014 less those noted as complete above.<br><br>Resource Allocation Manager:<br>- Continue all efforts of FY 2014 less those noted as complete above.<br><br>Digital Radar:<br>- Continue all efforts of FY 2014 less those noted as complete above.<br>- Complete system design for front-end.<br>- Initiate system build for front-end.<br><br>Low Band Communications, IO and EW:<br>- Continue all efforts of FY 2014 less those noted as complete above.<br>- Complete architecture and requirements.<br>- Initiate subsystem designs. | | | |
| ***Title:*** Netted Emulation of Multi-Element Signatures against Integrated Sensors (NEMESIS) | - | - | 9.150 |
| ***Description:*** The objective is to develop a System of Systems (SoS) able to coordinate distribute EW resources against many adversary surveillance and targeting sensors simultaneously. It will benefit the warfighter by providing platform protection across the battlespace against many sensors, creating seamless cross-domain countermeasure coordination, and enabling rapid advanced technology/capability insertion to counter emerging threats. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603271N / *Electromagnetic Systems Advanced Technology* | **Project (Number/Name)**<br>2913 / *Electromagnetic Systems Advanced Technology* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| a) Develop reconfigurable and modular EW payloads, Distributed Decoy and Jammer Swarms (DDJS), effective multi-spectral countermeasures (CM), and Multiple Input/Multiple Output Sensor/CM (MIMO S/CM) for platform protection across operational domains.<br><br>This R2 activity was initiated in FY 2014 in PE 0602271N and expanded in FY2015 to PE 0603271N.<br><br>***FY 2013 Accomplishments:***<br>N/A<br>***FY 2014 Plans:***<br>N/A<br>***FY 2015 Plans:***<br>- Initiate development and demonstration of the NEMESIS EW payloads and their integration into platforms.<br>- Initiate application of the research supporting distributed control, coordination and networking of NEMESIS payloads and platforms. | | | |
| **Accomplishments/Planned Programs Subtotals** | 51.848 | 56.179 | 64.623 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**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-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | R-1 Program Element (Number/Name)<br>PE 0603271N / *Electromagnetic Systems Advanced Technology* | Project (Number/Name)<br>9999 / *Congressional Adds* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9999: *Congressional Adds* | - | 8.250 | - | - | - | - | - | - | - | - | - | 8.250 |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

Congressional Interest Items not included in other Projects.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 |
|---|---|---|
| ***Congressional Add:*** Adv Radar Innovation Fund - S&T (Cong) | 8.250 | - |
| ***FY 2013 Accomplishments:*** -Development of a long range radar capability and electronic support measure system for identifying maritime targets.<br>-Ruggedization of back end processing equipment associated with the Affordable Common Radar Architecture system.<br>-Development and flight test a high resolution detector operating over the full radar volume.<br>-Initiate and integrate a high resolution camera to verify maritime target identification. | | |
| ***FY 2014 Plans:*** N/A | | |
| **Congressional Adds Subtotals** | 8.250 | - |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Congressional Interest Items not included in other Projects.

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | **R-1 Program Element (Number/Name)**<br>PE 0603640M *I MC Advanced Technology Demo* |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Program Element | 0.000 | 117.288 | 132.336 | 128.397 | - | 128.397 | 137.562 | 140.416 | 142.407 | 142.368 | Continuing | Continuing |
| 2223: *Marine Corps ATD* | 0.000 | 78.455 | 88.318 | 85.623 | - | 85.623 | 91.450 | 93.355 | 94.664 | 94.925 | Continuing | Continuing |
| 2297: *Marine Corps Warfighting Lab - Core* | 0.000 | 38.833 | 44.018 | 42.774 | - | 42.774 | 46.112 | 47.061 | 47.743 | 47.443 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 (June 2012). 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 United States 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 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 enhanced warfighting capabilities through field experiments with Marine operating forces; 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 and Invention (D&I) phases of Naval 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. The Marine Corps Service Campaign Plan (MCSCP) is the lens through which USMC S&T priorities are acted upon in order to support the future development of the Total Force.

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | **R-1 Program Element (Number/Name)**<br>PE 0603640M *I MC Advanced Technology Demo* |

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 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 130.598 | 132.400 | 135.244 | - | 135.244 |
| Current President's Budget | 117.288 | 132.336 | 128.397 | - | 128.397 |
| Total Adjustments | -13.310 | -0.064 | -6.847 | - | -6.847 |
| • Congressional General Reductions | - | -0.064 | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | - | - | | | |
| • SBIR/STTR Transfer | -2.343 | - | | | |
| • Rate/Misc Adjustments | - | - | -6.847 | - | -6.847 |
| • Congressional General Reductions Adjustments | -10.967 | - | - | - | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Project 2297, Worldwide contingency and combat operations (e.g., Operation Enduring Freedom (OEF) and humanitarian efforts) have increased the operations tempo of the operating forces to the extent that their support of, and participation in, the Marine Corps Warfighting Laboratory (MCWL) experimentation was/remains challenging to coordinate and often directly impacts planned projects. Additionally, rapid responses to emergent warfighter needs impacts planned projects. Also, experimentation itself is not a precise business and information gained throughout the process can also effect program plans. Thus, executing planned projects becomes "an art" in an effort to balance complicated and competing needs.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | R-1 Program Element (Number/Name)<br>PE 0603640M / *MC Advanced Technology Demo* | Project (Number/Name)<br>2223 / *Marine Corps ATD* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2223: *Marine Corps ATD* | - | 78.455 | 88.318 | 85.623 | - | 85.623 | 91.450 | 93.355 | 94.664 | 94.925 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS (C4) | 5.278 | 6.132 | 6.266 |
| ***Description:*** 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-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. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| The increase in the Command, Control, Communications, Computers (C4) funding from FY 2013 to FY 2014 is due to expanded development efforts and demonstrations of technologies that enhance urban communications capabilities.<br><br>***FY 2013 Accomplishments:***<br>- Continued urban navigation with limited Global Positioning System availability demonstrations.<br>- Continued demonstrations of improved urban communications capabilities.<br>- Continued creating a service oriented sensor network for expeditionary forces' current and future tactical sensors.<br>- Continued developing tailored tactical Human to Machine Interfaces aligned to primary operational functions and non-intrusive within the battlespace.<br>- Continued creating services for the tactical network that are fully operable with DCGS and the DCGS Integration Backbone.<br>- Continued Application-Network Architectures, Conformal Antenna Integration and Demonstration Spiral 2 and C3 for the Individual Marine Spiral Two.<br>- Continued Application Network Architecture (reprioritized from FY11) and Automated Small.<br>- Completed Application Network Architecture and Advanced Software Reconfigurable Relay.<br>- Initiated Advanced Communications Systems and Small Unit C3.<br>***FY 2014 Plans:***<br>- Continue all efforts from FY2013, except those noted as completed.<br>- Continue urban navigation with limited Global Positioning System availability demonstrations.<br>- Continue demonstrations of improved urban communications capabilities.<br>- Continue creating a service oriented sensor network for expeditionary forces' current and future tactical sensors.<br>- Continue developing tailored tactical Human to Machine Interfaces aligned to primary operational functions and non-intrusive within the battlespace.<br>- Continue creating services for the tactical network that are fully operable with DCGS and the DCGS Integration Backbone.<br>- Continue Application-Network Architectures, Conformal Antenna Integration and Demonstration Spiral 2 and C3 for the Individual Marine Spiral Two.<br>- Continue Application Network Architecture (reprioritized from FY11) and Automated Small.<br>- Continue Advanced Communications Systems and Small Unit C3.<br>- Initiate smart radio efforts.<br>***FY 2015 Plans:***<br>- Continue urban navigation with limited Global Positioning System availability demonstrations.<br>- Continue demonstrations of improved urban communications capabilities.<br>- Continue developing tailored tactical Human to Machine Interfaces aligned to primary operational functions and non-intrusive within the battlespace. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue creating services for the tactical network that are fully operable with DCGS and the DCGS Integration Backbone.<br>- Continue Application-Network Architectures, Conformal Antenna Integration and Demonstration Spiral 2 and C3 for the Individual Marine Spiral Two.<br>- Continue Application Network Architecture (reprioritized from FY11) and Automated Small.<br>- Continue Advanced Communications Systems and Small Unit C3.<br>- Continue smart radio efforts.<br>- Complete creating a service oriented sensor network for expeditionary forces' current and future tactical sensors.<br>- Initiate Tactical Cyber Warfare.<br>- Initiate mobile security.<br>- Initiate NNetworking On-The-Move Technology insertion. | | | |
| ***Title:*** FIREPOWER | 7.784 | 9.018 | 9.205 |
| ***Description:*** 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.<br><br>The increase in the Firepower funding from FY 2013 to FY 2014 is due to the Exploitation and Development (E&D) phase activities of the Awareness for Lightweight Engagements and Remote Targeting (ALERT) Program which is developing large aperture, lightweight lens with enhanced fields of view.<br><br>***FY 2013 Accomplishments:***<br>- Continued scalable effects conventional warhead concept development.<br>- Continued improved mortar munition integration and demonstrations.<br>- Continued development of targeting and engagement technologies for distributed operations collaborative fires integration and demonstrations.<br>- Continued design, development, prototyping and testing 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.<br>- Continued a Flight Control Kinematic Unit effort (effort renamed Flight Control Mortar). 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.<br>- Continued Non-Magnetic Azimuth Sensing (NMAS previously identified as completed in PB 2011).<br>- Continued development of Miniature Urban Missile, leveraging technology from MEMS, designation, guidance and control, and warhead design, to develop a shoulder launched missile capable of defeating a variety of targets. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of precision 60mm mortar system, to demonstrate increased precision, range, and lethality in a light mortar, providing indirect fire support through projectile flight trajectory shaping.<br>- Continued Exploitation and Development (E&D) portion of Non-Magnetic Azimuth Sensing (NMAS), with transition of mature technologies to newly initiated PE 0602750N Azimuth and Inertial Micro-electromechanical System (MEMS) Navigation System (AIM) to develop low cost, precision, inertial navigation systems for use in highly accurate handheld targeting systems, shoulder launched missiles, and munitions.<br>- Continued development, prototyping, and testing of lightweight technologies that provide individual Marine enhanced capabilities to detect and identify man-size targets out to maximum effective ranges of individual weapons during all visibility conditions (daylight, limited visibility, and darkness) by integrating multiple capabilities into a single system.<br>- Completed MEMS Initiation Safety Device (ISD) development and testing, for MilStd 1901A compliant igniters, to incorporate into current and developmental weapons propulsion systems.<br>- Completed development of MEMS S&A.<br>- Completed development of Caseless (CL) Ammunition.(Caseless (CL) Ammunition Effort. | | | |
| ***FY 2014 Plans:***<br>- Continue all efforts from FY2013, except those noted as completed.<br>- Continue scalable effects conventional warhead concept development.<br>- Continue improved mortar munition integration and demonstrations.<br>- Continue development of targeting and engagement technologies for distributed operations collaborative fires integration and demonstrations.<br>- Continue design, development, prototyping and testing 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.<br>- Continue a Flight Control Kinematic Unit effort (effort renamed Flight Control Mortar). 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.<br>- Continue Non-Magnetic Azimuth Sensing (NMAS previously identified as completed in PB 2011).<br>- Continue development of Miniature Urban Missile, leveraging technology from MEMS, designation, guidance and control, and warhead design, to develop a shoulder launched missile capable of defeating a variety of targets.<br>- Continue development of precision 60mm mortar system, to demonstrate increased precision, range, and lethality in a light mortar, providing indirect fire support through projectile flight trajectory shaping.<br>- Complete Exploitation and Development (E&D) portion of Non-Magnetic Azimuth Sensing (NMAS), with transition of mature technologies to newly initiated PE 0602750N Azimuth and Inertial Micro-electromechanical System (MEMS) Navigation System | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| (AIM) to develop low cost, precision, inertial navigation systems for use in highly accurate handheld targeting systems, shoulder launched missiles, and munitions.<br>- Complete development, prototyping, and testing of lightweight technologies that provide individual Marine enhanced capabilities to detect and identify man-size targets out to maximum effective ranges of individual weapons during all visibility conditions (daylight, limited visibility, and darkness) by integrating multiple capabilities into a single system.<br>- Initiate E&D portion of Awareness for Lightweight Engagements and Remote Targeting (ALERT) to develop large aperture, lightweight lens with enhanced fields of view.<br>- Initiate E&D portion of Semi-Autonomous Fires Technology (SAFT) to develop semi-autonomous fire control systems for use in next generation remote weapons systems, to enhance performance and minimize gunner/operator burden.<br>- Initiate Weapons Spectral Signature Characterization and Mitigation (WSSCM) to develop pigments, dyes, and polymers to mitigate Short Wave Infrared (SWIR) signature for weapons systems applications. | | | |
| ***FY 2015 Plans:***<br>- Continue development of targeting and engagement technologies for distributed operations collaborative fires integration and demonstrations.<br>- Continue design, development, prototyping and testing 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.<br>- Continue E&D portion of Awareness for Lightweight Engagements and Remote Targeting (ALERT) to develop large aperture, lightweight lens with enhanced fields of view.<br>- Continue E&D portion of Semi-Autonomous Fires Technology (SAFT) to develop semi-autonomous fire control systems for use in next generation remote weapons systems, to enhance performance and minimize gunner/operator burden.<br>- Complete scalable effects conventional warhead concept development.<br>- Complete improved mortar munition integration and demonstrations.<br>- Complete Flight Control Kinematic Unit effort (effort renamed Flight Control Mortar). 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.<br>- Complete Non-Magnetic Azimuth Sensing (NMAS previously identified as completed in PB 2011) technology.<br>- Complete development of Miniature Urban Missile, leveraging technology from MEMS, designation, guidance and control, and warhead design, to develop a shoulder launched missile capable of defeating a variety of targets.<br>- Complete development of precision 60mm mortar system, to demonstrate increased precision, range, and lethality in a light mortar, providing indirect fire support through projectile flight trajectory shaping.<br>- Complete Weapons Spectral Signature Characterization and Mitigation (WSSCM) to develop pigments, dyes, and polymers to mitigate Short Wave Infrared (SWIR) signature for weapons systems applications. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate investigation of the scalability of variable effects conventional munitions, gun, and propulsion technologies for improving firepower effectiveness while increasing affordability and decreasing logistics burden in support of expeditionary warfare.<br>- Initiate development of precision fires engagement technologies, to include trajectory shaped 81mm mortars, 83mm missiles, and smaller precision munitions. | | | |
| ***Title:*** FORCE PROTECTION | 8.168 | 9.467 | 9.613 |
| ***Description:*** 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 explosive hazards from the beach exit to inland objectives. Efforts supported under Force Protection also include the demonstration of technologies such as Air Defense/Counter Rocket, Artillery, and Mortar (CRAM) and counter tactical surveillance and targeting, including pre-shot sniper detection, technologies in support of maneuver warfare, small unit distributed operations, and technologies for improved Personnel Protective Equipment for individual protection against blast, ballistic, and blunt impact threats.<br><br>The increase in the Force Protection funding from FY 2013 to FY 2014 is due the initiation of a fusion of technologies project that will detect and classify optics, such as sniper scopes, from a moving platform.<br><br>***FY 2013 Accomplishments:***<br>- Continued development of technologies to defeat side/top attack and advanced fuze mines through signature reduction and advanced signature duplication.<br>- Continued development of technologies to locate and defeat IEDs.<br>- Continued development of technologies to defeat advanced mine fuzes (seismic, acoustic, and infrared).<br>- Continued efforts to detect IEDs using radio frequency sources.<br>- Continued technology development programs to address force protection capability gaps.<br>- Continued 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.<br>- Continued a new Anti-Tank Guided Missile (ATGM) effort to defeat ATGMs in complex urban environment.<br>- Continued Warfighter modeling and simulation efforts for the Warfighter-as-a-System analysis approach and methodology combining survivability, mobility, and warfighter performance parameters.<br>- Continued the Urgent Theater Warfighting Requirement for countering Improvised Explosive Devices (IED) and vehicle bourne IED.<br>- Continued high-power solid state source development for IED neutralization.<br>- Continued vulnerability assessment of threat targeting sensors to directed energy. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued efforts to neutralize incoming rocket, artillery, and mortar threats via non-kinetic means.<br>- Continued development and evaluation of landmine detection utilizing ground penetrating radar from an airborne platform.<br>- Continued development and evaluation of landmine detection utilizing synthetic aperture radar from an airborne platform.<br>- Continue to develop and demonstrate technologies that will detect RPGs and ATGMs prior to launch and countermeasures after launch.<br>- Initiated the development of detecting and locating sniper weapons using the return of their unique radar signatures.<br>- Initiated the development automated human detection via spectral imaging during low-light level operation conditions (e.g. dusk/ dawn/moonlit/starlit night).<br>- Initiated fusion of technologies that will detect and classify optics (sniper scopes, ccds, eyeball, etc) from a moving platform.<br>- Initiated the demonstration of the feasibility of a deployable mission package consisting of technologies capable of screening multiple individuals rapidly over a wide area to detect, classify and track suicide bombers at relevant distances within a critical time frame for action.<br>- Initiated demonstration of laser technology readiness for battlefield employment. | | | |
| ***FY 2014 Plans:***<br>- Continue all efforts from FY2013, except those noted as completed.<br>- Continue development of technologies to defeat side/top attack and advanced fuze mines through signature reduction and advanced signature duplication.<br>- Continue development of technologies to locate and defeat IEDs.<br>- Continue development of technologies to defeat advanced mine fuzes (seismic, acoustic, and infrared).<br>- Continue a new Anti-Tank Guided Missile (ATGM) effort to defeat ATGMs in complex urban environment.<br>- Continue Warfighter modeling and simulation efforts for the Warfighter-as-a-System analysis approach and methodology combining survivability, mobility, and warfighter performance parameters.<br>- Continue the development of detecting and locating sniper weapons using the return of their unique radar signatures.<br>- Continue the development automated human detection via spectral imaging during low-light level operation conditions (e.g. dusk/ dawn/moonlit/starlit night).<br>- Continue fusion of technologies that will detect and classify optics (sniper scopes, ccds, eyeball, etc) from a moving platform.<br>- Continue the demonstration of the feasibility of a deployable mission package consisting of technologies capable of screening multiple individuals rapidly over a wide area to detect, classify and track suicide bombers at relevant distances within a critical time frame for action.<br>- Continue demonstration of laser technology readiness for battlefield employment.<br>- Complete technology development programs to address force protection capability gaps. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete 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.<br>- Complete the Urgent Theater Warfighting Requirement for countering Improvised Explosive Devices (IED) and vehicle bourne IED.<br>- Complete high-power solid state source development for IED neutralization.<br>- Complete vulnerability assessment of threat targeting sensors to directed energy.<br>- Complete development and evaluation of landmine detection utilizing ground penetrating radar from an airborne platform.<br>- Complete efforts to neutralize incoming rocket, artillery, and mortar threats via non-kinetic means.<br>- Complete development and evaluation of landmine detection utilizing synthetic aperture radar from an airborne platform.<br>- Complete to develop and demonstrate technologies that will detect RPGs and ATGMs prior to launch and countermeasures after launch.<br>- Complete efforts to detect IEDs using radio frequency sources.<br>- Initiate physics-based characterization of signatures of proud/buried targets/EH Indicators across the spectrum of applicable detection modalities using knowledge/investigation of target physics.<br>- Initiate a program to demonstrate the fusion of multiple modes of detection of explosive hazards into a single system.<br>- Initiate development of advance modular and scalable personal protective equipment utilizing advances in mobility/survivability modeling and simulation, materials, and bio-fidelic surrogates.<br>- Initiate development of materials and helmet systems that absorb/dissipate blast shock waves. | | | |
| ***FY 2015 Plans:***<br>- Continue development of technologies to defeat side/top attack and advanced fuze mines through signature reduction and advanced signature duplication.<br>- Continue development of technologies to locate and defeat IEDs.<br>- Continue development of technologies to defeat advanced mine fuzes (seismic, acoustic, and infrared).<br>- Continue Anti-Tank Guided Missile (ATGM) effort to defeat ATGMs in complex urban environment.<br>- Continue Warfighter modeling and simulation efforts for the Warfighter-as-a-System analysis approach and methodology combining survivability, mobility, and warfighter performance parameters.<br>- Continue demonstration of laser technology readiness for battlefield employment.<br>- Continue physics-based characterization of signatures of proud/buried targets/explosive hazard indicators across the spectrum of applicable detection modalities using knowledge/investigation of target physics.<br>- Continue a program to demonstrate the fusion of multiple modes of detection of explosive hazards into a single system.<br>- Continue development of advance modular and scalable personal protective equipment utilizing advances in mobility/survivability modeling and simulation, materials, and bio-fidelic surrogates. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue development of materials and helmet systems that absorb/dissipate blast shock waves<br>- Complete the demonstration of the feasibility of a deployable mission package consisting of technologies capable of screening multiple individuals rapidly over a wide area to detect, classify and track suicide bombers at relevant distances within a critical time frame for action.<br>- Complete the development of detecting and locating sniper weapons using the return of their unique radar signatures.<br>- Complete fusion of technologies that will detect and classify optics (sniper scopes, ccds, eyeball, etc) from a moving platform.<br>- Complete the development of automated human detection via spectral imaging during low-light level operation conditions (e.g. dusk/dawn/moonlit/starlit night).<br>- Initiate an integrated technology demonstration to develop a system of systems that addresses route reconnaissance and clearance for a MEU.<br>- Initiate a project to develop organic technology solutions for the detection and clearance of explosive hazards and obstacles encountered by Marine Corps forces during amphibious operations.<br>- Initiate a project to investigate the detection and neutralization of explosive hazards in multiple, diverse, environments<br>- Initiate a program to fuse multiple technologies that will detect and classify tactical surveillance and targeting threats before engagement from a moving platform.<br>- Initiate projects to develop Personnel Protection Equipment (PPE) through novel Modular, Tailorable and scalable design concepts which increase survivability and operational suitability to the warfighter.<br>- Initiate broad based material (ceramics, fiber and Fiber Re-Enforced Plastics) to demonstrate the possibility of significant weight reductions (greater than 50%) can be achieved. | | | |
| ***Title:*** HUMAN PERFORMANCE, TRAINING & EDUCATION | 10.510 | 12.178 | 12.538 |
| ***Description:*** This activity addresses the applied research effort of the Human Performance Training and Education thrust (HPT&E). The HPT&E thrust investment profile is directed at two technology investment areas, Warrior Resilience, and Decision Making and Expertise Development. The funding aligned to Warrior Resilience is focused on advanced training technologies and methodologies that enhance neural, cognitive, and physical readiness. Those funds aligned to Decision Making and Expertise Development refers to training and education technologies and methodologies that accelerate the development and improve the retention of skills in decision making, situation awareness, and individual and team adaptability and coordination on decentralized, dynamic and dispersed battlefields.<br><br>The increase in the Human Performance, Training & Education funding from FY 2013 to FY 2014 is due to expanded emphasis by the Marine Corps on development of technologies and methodologies for integrated mental skills resilience training.<br><br>***FY 2013 Accomplishments:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of "Warfighter as a System" modeling tools. (Effort renamed to Enhancing warfighter psycho-physical performance).<br>- Continued development of adaptive experiential learning tools for Distributed Operations Training. (Effort renamed to Real-time adaptive training environments).<br>- Continued evaluations and validations of applications geared towards peak neural and cognitive performance-in distributed operations.<br>- Continued 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).<br>- Continued efforts to apply learning theories for language and culture training.<br>- Continued team immersive language and cultural learning in simulation environments.<br>- Continued classroom/field testing of 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. (Rename effort Algorithms Physiologically-derived to Promote Learning Efficiency (APPLE)).<br>- Continued field evaluations of training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise.<br>- Continued effectiveness and validation studies of Advanced Mobile Field Assessment and Readiness Technologies to improve the capability to assess situational awareness in the field and predict physical performance by developing mobile and rugged tools, algorithms, and models.<br>- Continued development of sleep deprivation mitigations (phase II) to enhance warfighter performance during extended operations (initial phase completed in FY10).<br>- Continued development of technologies supporting peak cognitive performance of warfighters.<br>- Continued development of physical conditioning assessment and training optimization methods to improve warfighter performance (previous efforts related to physical conditioning impacts on combat readiness resourced by PE 0602131M).<br>- Continued development of applied training technologies for Squad Immersive Training Environments (SITE).<br>- Continued evaluation of neurological symptoms of performance at altitude to reduce the incidences of acute mountain sickness (AMS).<br>- Continued development and demonstrate immersive training communication analysis systems to support instructor assessment of infantry units.<br>- Continued the assessment and validation of an injury prevention methodology for use in-theater (CoRE)<br>- Continued the demonstration of the utility of Integrated Learning Management System (LMS).<br>- Continued the development of Integrated Models for Warfighter Performance Enhancement. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued effectiveness and validation studies of Advanced Mobile Field Assessment and Readiness Technologies to improve the capability to assess situational awareness in the field and predict physical performance by developing mobile and rugged tools, algorithms, and models.<br>- Continued research into heat stress mitigations for the individual Warfighter, and develop intervention strategies to improve performance in hot environments.<br>- Continue development of an autonomous robotic adversarial target system to extend simulation marksmanship training to live-fire ranges with the use of robotic targets (all-terrain, mobile, tactical, return fire) and integrate with simulation feedback and scoring for transition to Marine Corps Systems Command (PM-Training Systems).<br>- Completed the demonstration of the utility of a comprehensive instructional strategies framework that takes as input learner and knowledge characteristics and then provides as output recommended strategies to developers for enhancing training within simulation based training environments (APPLE).<br>- Completed development of automated capture, measurement, performance assessment & after-action-review (AAR) for small team communications during training, showing improved situational awareness and team coordination among warfighters in a MOUT training environment (Relates to FY09 initiated effort to demonstrate and field studies of mitigation /augmentation capabilities that enhance squad communications).<br>- Completed studies into next generation physical performance enhancement methodologies and technologies (enhanced warfighter psycho-physical performance).<br>- Initiated mobile field technologies for predicting readiness and performance into more advanced development and demonstration of utility.<br>- Initiated development of technologies and methodologies for integrated mental skills resilience training (previous efforts neural mechanisms of mental skills resilience). | | | |
| ***FY 2014 Plans:***<br>- Continue all efforts from FY2013, except those noted as completed.<br>- Complete development of "Warfighter as a System" modeling tools. (Effort renamed to Enhancing warfighter psycho-physical performance).<br>- Complete development of adaptive experiential learning tools for Distributed Operations Training. (Effort renamed to Real-time adaptive training environments).<br>- Complete evaluations and validations of applications geared towards peak neural and cognitive performance-in distributed operations.<br>- Complete efforts to apply learning theories for language and culture training.<br>- Continue team immersive language and cultural learning in simulation environments.<br>- Continue development of physical conditioning assessment and training optimization methods to improve warfighter performance (previous efforts related to physical conditioning impacts on combat readiness resourced by PE 0602131M). | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue mobile field technologies for predicting readiness and performance into more advanced development and demonstration of utility.<br>- Continue development of technologies and methodologies for integrated mental skills resilience training (previous efforts neural mechanisms of mental skills resilience).<br>- Complete 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).<br>- Complete classroom/field testing of 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. (Rename effort Algorithms Physiologically-derived to Promote Learning Efficiency (APPLE)).<br>- Complete field evaluations of training mitigation strategies triggered by behavioral and neurophysiological markers of learning, cognition, and expertise.<br>- Complete development of an autonomous robotic adversarial target system to extend simulation marksmanship training to live-fire ranges with the use of robotic targets (all-terrain, mobile, tactical, return fire) and integrate with simulation feedback and scoring for transition to Marine Corps Systems Command (PM-Training Systems).<br>- Complete evaluation of neurological symptoms of performance at altitude to reduce the incidences of acute mountain sickness (AMS).<br>- Complete development and demonstrate immersive training communication analysis systems to support instructor assessment of infantry units.<br>- Complete development of sleep deprivation mitigations (phase II) to enhance warfighter performance during extended operations (initial phase completed in FY10).<br>- Complete development of technologies supporting peak cognitive performance of warfighters.<br>- Complete the demonstration of the utility of using Tyrosine supplementation for reducing stress in irregular warfare, asymmetric environments.<br>- Complete the development of the utility of analyzing neural mechanisms for affecting mental skills resilience.(- Complete the development of Integrated Models for Warfighter Performance Enhancement.<br>- Complete development of applied training technologies for Squad Immersive Training Environments(SITE).<br>- Complete the demonstration of the utility of Integrated Learning Management System (LMS).<br>- Complete the assessment and validation of an injury prevention methodology for use in-theater (CoRE).<br>- Complete effectiveness and validation studies of Advanced Mobile Field Assessment and Readiness Technologies to improve the capability to assess situational awareness in the field and predict physical performance by developing mobile and rugged tools, algorithms, and models. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete research into heat stress mitigations for the individual Warfighter, and develop intervention strategies to improve performance in hot environments.<br>- Initiate the development of small-unit training for adaptability and resiliency in decision making (STAR-DM), to enhance the Marine Air Ground Task Force's capabilities by training and equipping small-unit leaders to handle the demanding complexities and possess the adaptive mindset necessary to operate across the spectrum of conflict; empowering our strategic corporals as well as all of our junior leaders to fight, operate, and win in this challenging security environment.<br>- Initiate the development of rapid auto cognitive task analysis(AutoCTA), to address the problems associated with accurately determining training system requirements, to develop a standardized, theory driven and JCIDS aligned, rapid CTA technique for extracting knowledge from experts and efficiently modeling tasks.<br>- Initiate development of technology to improve the transfer and maintenance of resilience training in the Marine Corps, to include measures of climate for Warfighter resilience, and small unit leader and team member training to enhance climate resilience, social support, and relapse prevention modules for deployment. | | | |
| ***FY 2015 Plans:***<br>- Continue the development of small-unit training for adaptability and resiliency in decision making (SUDM), to enhance the Marine Air Ground Task Force's capabilities by training and equipping small-unit leaders to handle the demanding complexities and possess the adaptive mindset necessary to operate across the spectrum of conflict; empowering our strategic corporals as well as all of our junior leaders to fight, operate, and win in this challenging security environment. (previous efforts related to SUDM resourced by PE 0602131M).<br>- Complete team immersive language and cultural learning in simulation environments.<br>- Complete development of physical conditioning assessment and training optimization methods to improve warfighter performance (previous efforts related to physical conditioning impacts on combat readiness resourced by PE 0602131M).<br>- Complete mobile field technologies for predicting readiness and performance into more advanced development and demonstration of utility.<br>- Complete development of technologies and methodologies for integrated mental skills resilience training (previous efforts neural mechanisms of mental skills resilience).<br>- Complete the development of rapid auto cognitive task analysis(AutoCTA), to address the problems associated with accurately determining training system requirements, to develop a standardized, theory driven and JCIDS aligned, rapid CTA technique for extracting knowledge from experts and efficiently modeling tasks.<br>- Complete development of technology to improve the transfer and maintenance of resilience training in the Marine Corps, to include measures of climate for Warfighter resilience, and small unit leader and team member training to enhance climate resilience, social support, and relapse prevention modules for deployment. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate and complete development of better enhanced simulation and training (BEST) by applying a dynamic tailoring framework to create adaptive training. This effort initiated in FY 2014 due to urgent operational requirements.<br>- Initiate design and development of a Marine augmented classroom environment (ACE) that will enhance instructors' teaching performance and student learning outcomes. This effort initiated in FY 2014 due to operational requirements.<br>- Initiate design and development of a test-bed and conduct The Basic School evaluation to test the efficacy of simulation based training in that curriculum. This effort initiated in FY 2014 due to urgent operational requirements.<br>- Initiate development and demonstrate an agent-based surrogate instructor development environment (ASIDE) to allow USMC to field small-team focused intelligent training solutions. This effort initiated in FY 2013 due to operational requirements.<br>- Initiate development of training to optimize the use of resilience skills (TOURS), specifically develop and iterate training modules for relapse prevention, deployable refresher training, supports for transfer climate and social support for small unit leaders. This effort initiated in FY 2013 due to operational requirements.<br>- Initiate development of an individualized fatigue countermeasure training tool for Marines that will provide increased fatigue resilience training effectiveness, improved fatigue management and reduced fatigue-related operational errors. This effort initiated in FY 2013 due to operational requirements.<br>- Initiate development of a master instructor development system (MIND) which will provide measurement framework to support the develop of master instructors by creating a developmental model of instructor mastery.. This effort initiated in FY 2013 due to operational requirements.<br>- Initiate design and development of methods for establishing optimal training intervals for the Marine Corps Martial Arts Program (MCMAP) for improvement in physical performance and warrior mindset. This effort initiated in FY 2014 due to operational requirements. | | | |
| ***Title:*** INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR) | 3.927 | 4.551 | 4.650 |
| ***Description:*** 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.<br><br>The increase in the Intelligence, Surveillance, and Reconnaissance funding from FY 2013 to FY 2014 is due to accelerated development of a workflow manager capable of cloud service discovery and configuration. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***FY 2013 Accomplishments:***<br>- Continued development of advanced tactical sensor nets that localize mobile detection of threats in a complex environment.<br>- Continued development and demonstration of measurement and signature intelligence data management and integration capability.<br>- Continued integration and demonstration of naval tactical warfighting applications and network connectivity.<br>- Continued tagging, tracking, and locating efforts to demonstrate the effectiveness of tactically relevant tag readers which support track classification algorithms.<br>- Continued efforts to refine enemy course of action prediction software to adapt to stimuli.<br>- Continued 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.<br>- Continued development of tactical sensor nets with organic unattended multi-level security processing and information dissemination.<br>- Continued 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.<br>- Continued 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.<br>- Continued algorithm development for base classification on context, similarity to clutter, and nearness to suspicion.<br>- Continued 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.<br>- Continued efforts to incorporate social models for human decision making with statistical models.<br>- Continued efforts to extend the utility of track classification algorithms to sparse data.<br>- Continued efforts to automatically fuse data across all identifiers (TTL, biometrics, symbols) based on similarity measures.<br>- Continued efforts to show entity tracking using disparate ground and air sensors and tools that automatically compute latent area atmospheric measures.<br>- Continued development of model based own force decision tools based on adversarial decision making models.<br>- Continued development of an active layered sensing capability.<br>- Completed development of an active dynamic resource manager to make collected data better available to decision makers.<br>- Completed Operational Adaptation Enablers effort to provide one analysis framework for the incorporation of interdisciplinary techniques related to addressing contextual questions. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Completed efforts to analyze and expose enemy networks using close observations of entity to entity associations and social network analysis. This includes development of audio tools which enable automated understanding of analog and digital recordings, as well as text files.<br>- Initiated research on the development of automated data tagging algorithms that enable connected graphs of structured and unstructured data.<br>- Initiated research to develop more audio exploitation algorithms that can be used on audio files with a low signal to noise.<br>- Initiated technology development required to enable tactical UAS on-board processing of terabytes of data in real time.<br>- Initiated development of a user composable search and display capability enabled by map reduce technology.<br>- Initiated 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. | | | |
| ***FY 2014 Plans:***<br>- Continue all efforts from FY2013, except those noted as completed.<br>- Continue development of advanced tactical sensor nets that localize mobile detection of threats in a complex environment.<br>- Continue development and demonstration of measurement and signature intelligence data management and integration capability.<br>- Continue efforts to refine enemy course of action prediction software to adapt to stimuli.<br>- Continue 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.<br>- Continue development of tactical sensor nets with organic unattended multi-level security processing and information dissemination.<br>- Continue 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.<br>- Continue 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.<br>- Continue 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.<br>- Continue efforts to incorporate social models for human decision making with statistical models.<br>- Continue efforts to extend the utility of track classification algorithms to sparse data.<br>- Continue efforts to automatically fuse data across all identifiers (TTL, biometrics, symbols) based on similarity measures. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue efforts to show entity tracking using disparate ground and air sensors and tools that automatically compute latent area atmospheric measures.<br>- Continue development of model based own force decision tools based on adversarial decision making models.<br>- Continue development of an active layered sensing capability.<br>- Continue research to develop more audio exploitation algorithms that can be used on audio files with a low signal to noise.<br>- Continue technology development required to enable tactical UAS on-board processing of terabytes of data in real time.<br>- Continue development of a user composable search and display capability enabled by map reduce technology.<br>- Complete 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.<br>- Complete algorithm development for base classification on context, similarity to clutter, and nearness to suspicion.<br>- Complete integration and demonstration of naval tactical warfighting applications and network connectivity.<br>- Complete tagging, tracking, and locating efforts to demonstrate the effectiveness of tactically relevant tag readers which support track classification algorithms.<br>- Initiate the development of a workflow manager capable of cloud service discovery and configuration. | | | |
| ***FY 2015 Plans:***<br>- Continue 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.<br>- Continue the development of a workflow manager capable of cloud service discovery and configuration.<br>- Continue research on the development of automated data tagging algorithms that enable connected graphs of structured and unstructured data.<br>- Continue technology development required to enable tactical UAS on-board processing of terabytes of data in real time.<br>- Continue development of a user composable search and display capability enabled by map reduce technology.<br>- Continue 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.<br>- Complete development of advanced tactical sensor nets that localize mobile detection of threats in a complex environment.<br>- Complete development and demonstration of measurement and signature intelligence data management and integration capability.<br>- Complete efforts to refine enemy course of action prediction software to adapt to stimuli.<br>- Complete development of tactical sensor nets with organic unattended multi-level security processing and information dissemination. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete 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.<br>- Complete 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.<br>- Complete efforts to incorporate social models for human decision making with statistical models.<br>- Complete efforts to extend the utility of track classification algorithms to sparse data.<br>- Complete efforts to automatically fuse data across all identifiers (TTL, biometrics, symbols) based on similarity measures.<br>- Complete efforts to show entity tracking using disparate ground and air sensors and tools that automatically compute latent area atmospheric measures.<br>- Complete development of model based own force decision tools based on adversarial decision making models.<br>- Complete development of an active layered sensing capability.<br>- Complete research to develop more audio exploitation algorithms that can be used on audio files with a low signal to noise.<br>- Initiate research to develop concept based information retrieval from unstructured data sources based on structured grammars or intensity vectors.<br>- Initiate research to develop a capacity to run tracklett fusion, track analysis and data to track or track to track correlation as a distributed service run as a map-reduce job, both forensically and in real time.<br>- Initiate research to develop a prototype system capable of maintaining the entity models needed for entity co referencing during real time natural language processing workflows.<br>- Initiate research on the development of a capability to automate the extraction of video events relevant to mission information needs in real time on power efficient hardware.<br>- Initiate research on implementing orchestrated advanced analytics running across cloud and non-cloud based architectures. | | | |
| ***Title:*** LITTORAL COMBAT/POWER PROJECTION (LC/PP)<br>***Description:*** This activity addresses the advanced technology development associated with associated with the Marine Corps participation in the Department of the Navy's (DoN) Science and Technology Future Naval Capabilities (FNC) Program. The FNC Program represents the requirements-driven, delivery-oriented portion of the DoN Science and Technology (S&T) portfolio. FNC investments respond to Naval S&T Gaps that are generated by the Navy and Marine Corps after receiving input from Naval Research Enterprise (NRE) stakeholders. The funding is aligned with the Naval challenges associated with projecting power despite anti-access and area denial, specifically the Sea Shield, Power and Energy, FORCEnet, and the Naval Expeditionary Maneuver Warfare warfighting capability gaps. The funding profile reflects the alignment of the FNC program investments into Enabling Capabilities (ECs); ECs respond to priority Naval warfighting capability gaps. Funding for each EC is aligned to a 6.2 or 6.3 Budget Activity (BA) as appropriate. Concurrent funding for Naval expeditionary warfare capability ECs is also provided | 18.616 | 18.988 | 19.368 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| from Navy PE0602750N and PE0603673N. Both of the Navy PE's were included in the FY 2013 President's Budget Request and are now the only Navy program elements funding Navy FNC work. In previous submissions 7 Navy 6.2 PEs and 8 Navy 6.3 PEs funded FNC efforts.<br><br>***FY 2013 Accomplishments:***<br>- Continued development of modular scalable effects prototype weapon. (Concurrent funding from PE 0602131M).<br>- Continued development of tactical urban breaching technologies.<br>- Continued development of counter improvised explosive devices technologies. (Concurrent funding from PE 0602131M).<br>- Continued 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 2010).<br>- Continued development of technologies to lighten 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 Graphical User Interface (GUI-based) software for tradeoff analyses based on Military Operational Posture. (Previous FY10 effort resourced by PE 0602236N and PE 0603236N. Concurrent FY11 funding provided by PE 0602131M and PE 0603236N).<br>- Continued development of wide area surgical and persistent surveillance technologies. (Concurrent funding in PE 0602271N and PE 0602131M).<br>- Completed development of improved lightweight computational fire control interface technology.<br>- Completed development of improved fire control systems technologies to Expeditionary Fire Support System artillery and mortar systems.<br>- Completed development of transparent urban structures technologies.<br>- Completed development of individual Warfighter protection technologies.<br>- Initiated development of precision urban mortar attack technologies in FY11 due to operation contingencies. (Concurrent funding in PE 0602131M).<br>- Initiated development of fuel efficient Medium Tactical Vehicle Replacement (MTVR) technologies. (Concurrent funding in PE 0602131M).<br>- Initiated development of the Ground Based Air Defense On-the-move high energy laser demonstrator. (Concurrent funding in PE0602750N and PE0603673N)<br><br>***FY 2014 Plans:***<br>- Continue all efforts from FY 2013, except those noted as completed.<br>- Continue development of modular scalable effects prototype weapon. (Concurrent funding from PE 0602131M).<br>- Continue development of tactical urban breaching technologies.<br>- Continue development of counter improvised explosive devices technologies. (Concurrent funding from PE 0602131M). | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue 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 2010).<br>- Continue development of technologies to lighten 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 Graphical User Interface (GUI-based) software for tradeoff analyses based on Military Operational Posture. (Previous FY10 effort resourced by PE 0602236N and PE 0603236N. Concurrent FY11 funding provided by PE 0602131M and PE 0603236N).<br>- Continue development of wide area surgical and persistent surveillance technologies. (Concurrent funding in PE 0602271N and PE 0602131M).<br>- Continue development of precision urban mortar attack technologies in FY11 due to operation contingencies. (Concurrent funding in PE 0602131M).<br>- Continue development of fuel efficient Medium Tactical Vehicle Replacement (MTVR) technologies. (Concurrent funding in PE 0602131M).<br>- Continue development of the Ground Based Air Defense On-the-move high energy laser demonstrator. (Concurrent funding in PE0602750N and PE0603673N)<br>- Complete development of technologies to lighten-the-load of warfighters by 1) reducing the weight and improving the capability of the day/night weapon sight 2) eliminating battery incompatibility, 3) providing Graphical User Interface (GUI)-based software for tradeoff analyses based on Military Operational Posture.<br>- Complete development of precision universal mortar attack technologies. (Concurrent funding in PE 0602131M). | | | |
| ***FY 2015 Plans:***<br>- Continue development of wide area surgical and persistent surveillance technologies. (Concurrent funding in PE 0602131M).<br>- Continue development of the Ground Based Air Defense On-the-move high energy laser demonstrator. (Concurrent funding in PE 0602131M.)<br>- Continue development of modular scalable effects prototype weapon. (Concurrent funding from PE 0602131M).<br>- Continue development of tactical urban breaching technologies.<br>- Continue development of counter improvised explosive devices technologies. (Concurrent funding from PE 0602131M).<br>- Continue 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 2010).<br>- Continue development of technologies to lighten 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 Graphical User Interface (GUI-based) software for tradeoff analyses based on Military Operational Posture. (Previous FY10 effort resourced by PE 0602236N and PE 0603236N. Concurrent FY11 funding provided by PE 0602131M and PE 0603236N).<br>- Continue development of precision urban mortar attack technologies in FY11 due to operation contingencies. (Concurrent funding in PE 0602131M). | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete development of fuel efficient Medium Tactical Vehicle Replacement (MTVR) technologies. (Concurrent funding in PE 0602131M).<br>- Initiate development of an azimuth and inertial navigation system. (Effort was previously funded by PE 0602750N and PE 0603673N; concurrent funding in PE 0602131M.)<br>- Initiate and complete development of spectral and reconnaissance imagery for tactical exploitation (SPRITE). (Previous and follow-on funding provided by PE 0602750N and PE 0603673N; concurrent funding in PE 0602131M.)<br>- Initiate development of Target Processing Center (TPC) sensor correlation and fusion technology; specifically, context fusion, and radar fusion and false track mitigation. (Concurrent funding in PE 0602131M.)<br>- Initiate development of technologies to enable the exchange of actionable information at the tactical edge; specifically, actionable information tactical applications, data conditioning and network adaptive communication services. (Effort was previously funded by PE 0602750N and PE 0603673N; concurrent funding in PE 0603640M.) | | | |
| ***Title:*** LOGISTICS | 11.537 | 13.364 | 11.298 |
| ***Description:*** 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.<br><br>The increase in the Logistics funding from FY 2013 to FY 2014 is due to expanded field demonstrations for the Marine Corps of renewable energy devices and deployable equipment.<br><br>The FY 2014 to FY 2015 decrease in the Logistics Thrust Activity is due to a reduction in the scope and size of anti-fouling and non-fouling water purification components to enable enduring performance of small water purification systems.<br><br>***FY 2013 Accomplishments:***<br>- Continued exploring the development of portable fuel cell technologies capable of providing Power in the 100 Watt to 500 Watt power range.<br>- Continued efforts to develop a micro turbine generator capable of 100W average power.<br>- 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).<br>- Continued analysis of material alternatives for automated vehicle health monitoring and reporting. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued development of a backpack that prevents oscillatory and transient peak loading forces from causing skeletal injury while enhancing human mobility with heavy loads.<br>- Continued development of advanced lightweight fuel to energy conversion concepts. This includes development of power management electronics for reducing power requirements for military radios.<br>- Continued demonstration of advanced concepts for mobile infrastructure.<br>- Completed the development and demonstration of advanced materials for corrosion prevention and wear reduction for USMC vehicles and equipment.<br>- Initiated integration and demonstration of electrochemical ultracapacitors into hybrid electric power systems.<br>- Initiated efforts to improve advanced electrical power generation from fuel cells and renewable sources as well as to improve the efficiency of conventional generation via hybridization and smart-grid technologies.<br>- Initiated integration and demonstration of advanced materials to reduce maintenance into selected vehicle and machinery components.<br>- Initiated the development of robotic systems to facilitate the packaging and handling of logistic supplies. | | | |
| ***FY 2014 Plans:***<br>- Continue all efforts from FY 2013, except those noted as completed.<br>- Continue exploring the development of portable fuel cell technologies capable of providing Power in the 100 Watt to 500 Watt power range.<br>- Continue efforts to develop a micro turbine generator capable of 100W average power.<br>- Continue 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).<br>- Continue analysis of material alternatives for automated vehicle health monitoring and reporting.<br>- Continue development of a backpack that prevents oscillatory and transient peak loading forces from causing skeletal injury while enhancing human mobility with heavy loads.<br>- Continue development of advanced lightweight fuel to energy conversion concepts. This includes development of power management electronics for reducing power requirements for military radios.<br>- Continue demonstration of advanced concepts for mobile infrastructure.<br>- Continue integration and demonstration of electrochemical ultracapacitors into hybrid electric power systems.<br>- Continue efforts to improve advanced electrical power generation from fuel cells and renewable sources as well as to improve the efficiency of conventional generation via hybridization and smart-grid technologies.<br>- Continue integration and demonstration of advanced materials to reduce maintenance into selected vehicle and machinery components.<br>- Continue the development of robotic systems to facilitate the packaging and handling of logistic supplies. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate a field demonstration of renewable energy devices and deployable equipment showing fewer liabilities when delivering expensive fuel, thereby lowering Marine Corps operational costs. | | | |
| ***FY 2015 Plans:***<br>- Continue exploring the development of portable fuel cell technologies capable of providing Power in the 100 Watt to 500 Watt power range.<br>- Continue analysis of material alternatives for automated vehicle health monitoring and reporting.<br>- Continue demonstration of advanced concepts for mobile infrastructure.<br>- Continue integration and demonstration of electrochemical ultracapacitors into hybrid electric power systems.<br>- Continue efforts to improve advanced electrical power generation from fuel cells and renewable sources as well as to improve the efficiency of conventional generation via hybridization and smart-grid technologies.<br>- Continue integration and demonstration of advanced materials to reduce maintenance into selected vehicle and machinery components.<br>- Continue the development of robotic systems to facilitate the packaging and handling of logistic supplies.<br>- Continue a field demonstration of renewable energy devices and deployable equipment showing fewer liabilities when delivering expensive fuel, thereby lowering Marine Corps operational costs.<br>- Complete efforts to develop a micro turbine generator capable of 100W average power.<br>- Complete 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).<br>- Complete development of a backpack that prevents oscillatory and transient peak loading forces from causing skeletal injury while enhancing human mobility with heavy loads.<br>- Complete development of advanced lightweight fuel to energy conversion concepts. This includes development of power management electronics for reducing power requirements for military radios.<br>- Initiate operations research and analysis efforts to enhance seabased expeditionary supply chain concepts and technologies. (Some analyses fall under PE0602131M, while more mature efforts fall under PE0603640M)<br>- Initiate development of alternative (non-electrochemical) energy storage technologies for hybrid power system load management.<br>- Initiate development of low energy desalination technologies to allow for efficient salt-water purification at the small/individual scale.<br>- Initiate the development of anti-fouling and non-fouling water purification components to enable enduring performance of small water purification systems.<br>- Initiate the development of real-time water quality monitoring systems for use with small scale water purification systems. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate the development of efficient water packaging and distribution technologies. | | | |
| ***Title:*** MANEUVER | 12.635 | 14.620 | 12.685 |

***Description:*** 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 increase in the Maneuver Activity funding from FY 2013 to FY 2014 is due to higher costs associated with the development of autonomy technologies and system concepts that will enable unmanned ground vehicles (UGVs) to be used as autonomous logistic connector vehicles.

The FY 2014 to FY 2015 decrease in the Maneuver Thrust Activity is due to a reduction in scope of development of a vehicle demonstrator that focuses on enhanced crew survivability.

***FY 2013 Accomplishments:***
- Continued Advanced Electromagnetic Armor technology development efforts.
- Continued development of fuel efficiency and battlefield power systems for improved performance.
- Continued development of a Combat S&T Vehicle demonstrator to enhance crew survivability and vehicle fuel efficiency.
- Continued survivability improvements and technologies to mitigate acceleration and traumatic brain injuries to occupants to enhance tactical mobility and survivability.
- Continued 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.
- Continued 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.
- Continued 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.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued 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.<br>- Continued studies to identify technology development plans to close identified force protection capability gaps.<br>- Continued 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.<br>- Continued efforts to evaluate current ground fleet platforms for their mobility and control capabilities as they relate to potential inclusion of an autonomous vehicle capability that will provide mobility and logistics support to the dismounted Marine during Enhanced Company Operations (ECO).<br>- Continued efforts to demonstrate Integrated Armor Solutions that provide lighter weight armor materials with enhanced protection to vehicle occupants thereby enhancing tactical Mobility and Survivability in support of Distributed Operations.<br>- Continued programs to address and enhance maneuver capability gaps in mobility such as efforts, transitioned from 6.2, aimed at the development of an autonomous vehicle capability that will provide mobility and logistics support to the dismounted Marine during Enhanced Company Operations (ECO). | | | |
| ***FY 2014 Plans:***<br>- Continue all efforts from FY2013, except those noted as completed.<br>- Continue Advanced Electromagnetic Armor technology development efforts.<br>- Continue development of fuel efficiency and battlefield power systems for improved performance.<br>- Continue development of a Combat S&T Vehicle demonstrator to enhance crew survivability and vehicle fuel efficiency.<br>- Continue survivability improvements and technologies to mitigate acceleration and traumatic brain injuries to occupants to enhance tactical mobility and survivability.<br>- Continue 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.<br>- Continue 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.<br>- Continue 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.<br>- Continue 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.<br>- Continue studies to identify technology development plans to close identified force protection capability gaps.<br>- Continue 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. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue efforts to evaluate current ground fleet platforms for their mobility and control capabilities as they relate to potential inclusion of an autonomous vehicle capability that will provide mobility and logistics support to the dismounted Marine during Enhanced Company Operations (ECO).<br>- Continue efforts to demonstrate Integrated Armor Solutions that provide lighter weight armor materials with enhanced protection to vehicle occupants thereby enhancing tactical Mobility and Survivability in support of Distributed Operations.<br>- Continue programs to address and enhance maneuver capability gaps in mobility such as efforts, transitioned from 6.2, aimed at the development of an autonomous vehicle capability that will provide mobility and logistics support to the dismounted Marine during Enhanced Company Operations (ECO).<br>- Initiate the development of autonomy technologies and system concepts that will enable unmanned ground vehicles (UGVs) to be used as autonomous logistic connector vehicles.<br>- Initiate the development of fuel saving vehicle technologies, including advanced transmission, power train, and electrical power system technologies.<br>- Initiate mobility technologies that enable improved vehicle agility and stability.<br>- Initiate lightweight armor, material, and structural technologies that enable maneuver and survivability of small, light expeditionary platforms.<br>- Initiate survivability technologies that enable defeat of all unitary and tandem RPG and select ATGM threats, and the demonstration of survivable vehicles.<br>- Initiate the development of technologies that enable vehicle component modularity and reduce life cycle costs. | | | |
| ***FY 2015 Plans:***<br>- Continue advanced electromagnetic armor technology development efforts.<br>- Continue development of fuel efficiency and battlefield power systems for improved performance.<br>- Continue survivability improvements and technologies to mitigate acceleration and traumatic brain injuries to occupants to enhance tactical mobility and survivability.<br>- Continue 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.<br>- Continue 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.<br>- Continue efforts evaluating the current ground fleet platforms for their mobility and control capabilities as they relate to inclusion of an autonomous vehicle capability that will provide support to the dismounted Marine during Enhanced Company Operations (ECO).<br>- Continue efforts to demonstrate integrated armor solutions that provide lighter weight armor materials with enhanced protection to vehicle occupants thereby enhancing tactical mobility and survivability. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue programs to address and enhance maneuver capability gaps in mobility such as efforts, transitioned from 6.2, aimed at the development of an autonomous vehicle capability that will provide mobility and logistics support to the dismounted Marine during Enhanced Company Operations (ECO).<br>- Continue the development of autonomy technologies and system concepts that will enable unmanned ground vehicles (UGVs) to be used as autonomous logistic connector vehicles.<br>- Continue the development of fuel saving vehicle technologies, including advanced transmission, power train, and electrical power system technologies.<br>- Continue mobility technologies that enable improved vehicle/warfighter agility and stability.<br>- Continue lightweight armor, material, and structural technologies that enable maneuver and survivability of small, light expeditionary platforms.<br>- Continue survivability technologies that enable defeat of all unitary and tandem RPG and select ATGM threats, and the demonstration of survivable vehicles.<br>- Continue the development of technologies that enable vehicle component modularity and reduce life cycle costs.<br>- Continued development of a Combat S&T Vehicle demonstrator to enhance crew survivability and vehicle fuel efficiency.<br>- Continue 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.<br>- Continued 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.<br>- Continue studies to identify technology development plans to close identified force protection capability gaps.<br>- Continue 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.<br>- Initiate development of a vehicle demonstrator that focuses on enhanced crew survivability.<br>- Initiate the development of autonomous perception technologies to enable operations under adverse atmospheric conditions. | | | |
| **Accomplishments/Planned Programs Subtotals** | 78.455 | 88.318 | 85.623 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2223 / *Marine Corps ATD* |

**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, RDT&E Project Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | | | | | R-1 Program Element (Number/Name)<br>PE 0603640M / *MC Advanced Technology Demo* | | | | Project (Number/Name)<br>2297 / *Marine Corps Warfighting Lab - Core* | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| 2297: *Marine Corps Warfighting Lab - Core* | - | 38.833 | 44.018 | 42.774 | - | 42.774 | 46.112 | 47.061 | 47.743 | 47.443 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

As part of the Futures Directorate (FD), of Combat Development and Integration (CD&I), the Commanding General (CG) of the Marine Corps Warfighting Laboratory (MCWL) also serves as the United States Marine Corps (USMC) Executive Agent for Marine Corps Science and Technology (S&T). MCWL's mission is to enhance the current and determine the future Marine Corps strategic landscape. This is accomplished by assessing the Marine Corps' next warfighting concepts and capabilities via development and evaluation of innovative tactics, techniques, procedures, organizations, and technologies using an integral combination of concept based experimentation, technology assessments, wargaming, and analysis which will provide the strategic axis of advance for the Corps' entire enterprise. The FD also serves as the Marine Corps' liaison to the Joint Staff for Joint Concept Development and Experimentation; thereby facilitating service-specific experiments as well as participation in joint service experimentation.

Wargames are conducted to frame emerging warfighting concepts, establish the Joint context for the Marine Corps Force Development System, and establish priorities for development of experimental and non-experimental capabilities.

Modeling and Simulation (M&S)-based events allow MCWL to examine capabilities with larger scale venues and forces than is practical with live forces at lower cost in terms of funding and in terms of operating force personnel and equipment. M&S also enables assessment of proposed capabilities before making investments in costly concept demonstrator technologies required in live force experiments.

Technology investigations, investments, and assessments are conducted to identify, modify where appropriate, and evaluate technological capabilities that support advanced warfighting concepts, and to explore the military utility of promising new commercial or government technologies in support of urgent and compelling needs.

Live force 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: Combat Service Support (CSS) and Force Protection; Command, Control, Communications, and Computers (C4); Intelligence, Surveillance, and Reconnaissance (ISR); Fires, Targeting, and Maneuver; 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. These events are planned and scheduled as part of a series of experimentation campaigns focused on one or more central warfighting concepts. These campaigns are executed under the guidance of the Commandant of the Marine Corps (CMC) and under the auspices of the Deputy Commandant (DC), CD&I.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2297 / *Marine Corps Warfighting Lab - Core* |

The current Futures Directorate Campaign Plan (FDCP), formerly the MCWL Campaign Plan (MCP) addresses the challenges associated with the Enhanced Marine Air-Ground Task Force (MAGTF) Operations (EMO), Ship To Objective Maneuver (STOM), and Seabasing concepts. This campaign began in FY 2011 and is projected to culminate with an Advanced Warfighting Experiment (AWE) in 2014. EMO experimentation seeks to capitalize on the enhancements achieved during the previous MCWL campaign, Enhanced Company Operations (ECO), completed in FY 2010, which centered on expanding the combat capabilities of the Marine Infantry Company. EMO experimentation examines and develops the capabilities of other elements of the MAGTF beyond the infantry company. Focus areas for this effort are Logistics, Command and Control (C2), and Fires, Targeting, and Maneuver.

Upon completion of EMO experimentation in FY 2014, MCWL will shift focus in FY 2015 to experimentation based on the challenges associated with achieving the goals expressed in the Secretary of the Navy's "Cooperative Strategy 21" and the Marine Corps' follow-on "Expeditionary Force 21" (EF21) concept. MCWL will pursue experimentation that support flexible and sustainable MAGTFs employing distributed tactical formations across the range of military operations. MCWL will also examine future enhancements in training, organization, and equipment for immediate crisis response, with projects such as such as Fly-in Integrated Command Element (FICE). The goal of this concept-based line of experimentation is to support the continued operationalization of the concepts of Distributed Operations (DO), Operational Maneuver From The Sea (OMFTS), STOM, and Seabasing.

Finally, the CMC designated MCWL as the lead agency for all USMC Counter Improvised Explosive Device (CIED) activities, thereby extending MCWL's responsibilities in this critical area. MCWL continues to support the immediate needs of deployed forces and exploit opportunities presented by promising emerging technologies.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** COMBAT SERVICE SUPPORT (CSS) AND FORCE PROTECTION | 6.141 | 6.392 | 6.211 |
| ***Description:*** 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 2013 Accomplishments:***<br>- Continued to develop and experiment with bio-sciences (medical) technologies.<br>- Continued assessment of unmanned ground logistics delivery technologies that support infantry small unit operations.<br>- Continued assessment of technologies for sustainment of tactical level units from the sea-base.<br>- Continued a MCWL-Defense Advanced Research Projects Agency (DARPA) partnership for the development and demonstration of a MCWL centric legged robot in an effort to "Lighten the Load" of individual Marines.<br>- Continued research and assessment of technologies that reduce the demand required to support the MAGTF by completing development and assessment of a Marine Corps version of an Adaptive Logistics System as an operational as well as tactical level logistics decision support tool.<br>- Continued testing and evaluation of blast sensors that may improve the medical treatment for potential Traumatic Brain Injury casualties. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2297 / *Marine Corps Warfighting Lab - Core* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Completed development, and testing of unmanned versions of current cargo vehicles.<br><br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013, less those noted as completed above.<br>- Complete assessment of technologies for sustainment of tactical level units from the sea-base.<br>- Complete testing and evaluation of blast sensors that may improve the medical treatment for potential Traumatic Brain Injury casualties.<br>- Initiate development and assessment of counter-unmanned aerial systems (UAS) and unmanned ground vehicle (UGV) systems and TTPs.<br>- Initiate testing and assessment of logistics enablers in support of EF21 experimentation.<br><br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as complete above.<br>- Initiate assessment and experimentation with technologies that provide enhanced medical care over a distributed battlefied, to include "virtual" care and the use of autonomous systems in support of medical evacuation over ground, surface (water), or air.<br>- Initiate evaluation and assessment of emerging technologies that support energy demand reduction.<br>- Initiate investigation and assessment of logistics related emerging autonomous and robotic technologies and capabilities that further enhance current Programs of Record (PORs) and influence future planning and decision making. | | | |
| ***Title:*** FIRES, TARGETING, AND MANEUVER<br><br>***Description:*** 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.<br><br>The increase in MCWL Fires, Targeting, and Maneuver activity funding from FY 2013 to FY 2014 is due to the pursuit of investigations into weaponized unmanned ground robotic and autonomous systems as well as ship-to-shore connectors.<br><br>***FY 2013 Accomplishments:***<br>- Continued investigation, development, and testing of concept demonstrator technologies and TTPs for enhanced fire support and fire support coordination associated with the EMO concept.<br>- Continued development and assessment of weaponized unmanned ground robotic systems.<br>- Completed assessment of concept demonstrator precision targeting devices.<br>- Initiated and completed development and evaluation of an enhanced sniper sighting system.<br><br>***FY 2014 Plans:*** | 3.156 | 4.321 | 4.000 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2297 / *Marine Corps Warfighting Lab - Core* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts from FY 2013, less those noted as completed above.<br>- Complete investigation, development, and testing of concept demonstrator technologies and TTPs for enhanced fire support and fire support coordination associated with the EMO concept.<br>- Initiate development of technologies that enhance the utility of autonomous systems.<br>- Initiate test and assessment of future ship to shore connectors that support EF21.<br>***FY 2015 Plans:***<br>- Continue all efforts from FY 2014, less those noted as completed above.<br>- Initiate investigation of innovative technologies to enhance squad-level capabilities.<br>- Initiate evaluation and experimentation with technologies that can identify, neutralize, or destroy unmanned systems (aerial, ground, or surface).<br>- Initiate evaluation and assessment of both airborne and ground weaponized autonomous/semi-autonomous "man-in-the-loop" systems. | | | |
| ***Title:*** COMMAND, CONTROL, COMMUNICATIONS, AND COMPUTERS (C4)<br>***Description:*** 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.<br>***FY 2013 Accomplishments:***<br>- Continued C4 extended user assessments of selected prototype technologies in support of forces engaged in Operation Enduring Freedom (OEF).<br>- Continued assessment of enhanced MAGTF communications concept demonstrators.<br>- Continued development and assessment of Internally Transportable Vehicle (ITV) based C4 concept demonstrator.<br>- Continued investigation and assessment of a MAGTF C2 architecture and an integrated C2 application in support of the EMO concept.<br>- Continued development and assessment of a MAGTF network management system.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013.<br>- Complete C4 extended user assessments of selected prototype technologies in support of forces engaged in OEF.<br>- Complete assessment of enhanced MAGTF communications concept demonstrators.<br>- Complete development and assessment of ITV based C4 concept demonstrator. | 11.005 | 10.919 | 10.611 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2297 / *Marine Corps Warfighting Lab - Core* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete investigation and assessment of a MAGTF C2 architecture and an integrated C2 application in support of the EMO concept.<br>- Initiate development and assessment of a configurable C2 suite that enables operations from alternate seabased platforms in support of Expeditionary Force 21 (EF21) experimentation.<br>- Initiate development and assessment of a configurable C2 suite that enhances operations from L-Class shipping in support of EF21 experimentation.<br>- Initiate a follow-on effort to continue test and evaluation of an integrated C2 application in support of EF21 experimentation.<br>***FY 2015 Plans:***<br>- Continued all efforts of FY 2014, less those notes as completed above.<br>- Initiate development and assessment of systems that permit UAS operations in a global positioning system (GPS) denied environment.<br>- Initiate development and assessment of a configurable C2 suite that enhances operations from aviation platforms in support of EF21 experimentation.<br>- Initiate investigations and assessment of technologies that support C2 enablers for shore deployed MAGTF elements that is platform agnostic and capable of deployment from the sea, air, or ground.<br>- Initiate evaluation and experimentation with emerging technologies that support future maritime C2 capabilities/EF21.<br>- Initiate development and assessment of technologies that support a maritime FICE capable of operating from the sea-base during the conduct of immediate crisis response operations. | | | |
| ***Title:*** INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR) | 0.941 | 3.294 | 2.558 |
| ***Description:*** 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. 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.<br><br>The increase in MCWL ISR activity funding from FY 2013 to FY 2014 is due to an increased investment in technologies that integrate MAGTF level C4 ISR network abilities. This investment level decreases between FY 2014 and FY 2015.<br><br>***FY 2013 Accomplishments:***<br>- Continued additional IED investigations into promising detect and neutralize technologies.<br>- Completed investigations into rotary wing/hovering tactical level UAS concept demonstrators.<br>- Initiated assessment of integrated MAGTF level C4 ISR network in support of EMO efforts.<br>***FY 2014 Plans:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2297 / *Marine Corps Warfighting Lab - Core* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue all efforts of FY 2013, less those noted as completed above.<br>- Complete assessment of integrated MAGTF level C4 ISR network in support of EMO efforts.<br>- Initiate development and assessment of seabased and landing force ISR capabilities that enable Expeditionary Force 21 (EF21) experimentation.<br>- Initiate development and assessment of counter-UAS and unmanned ground vehicle (UGV) systems and TTPs.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Complete IED investigations into promising detect and neutralize technologies.<br>- Initiate development and assessment of enhanced UAS sensor packages.<br>- Initiate examination and assessment of technologies that support future employment of UAS operations from sea-based platforms. | | | |
| ***Title:*** MARINE CORPS WARFIGHTING LABORATORY (MCWL) OPERATIONS (SUPPORT)<br>***Description:*** 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.<br>***FY 2013 Accomplishments:***<br>- Continued to synthesize results and lessons learned into proposed DOTMLPF recommendations for the Marine Corps.<br>- Continued to provide technical, strategic, and managerial support to Marine Corps experimentation.<br>- Continued to provide overall analysis and reporting of experimentation efforts, analytical assistance during experiment design, and maintenance of an ad-hoc analysis capability.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014.<br>- Initiate deliberate broad-based commercial technology forecasting in support of experimentation long-range planning and combat development.<br>- Initiate technical, strategic, and managerial support for operations with advanced technology utilizing autonomy, robotics, and cyber capabilities. | 11.409 | 11.109 | 11.151 |
| ***Title:*** WARFIGHTING EXCELLENCE | 6.181 | 7.983 | 8.243 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2297 / *Marine Corps Warfighting Lab - Core* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Description:*** 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.<br><br>The increase in MCWL Warfighting Excellence activity funding from FY 2013 to FY 2014 is due to increased focus on M&S based training, to include investment into improving Wargaming abilities.<br><br>***FY 2013 Accomplishments:***<br>- Continued executive agent responsibilities for Joint Title Ten (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.<br>- 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.<br>- 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.<br>- 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.<br>- Continued experimentation of simulation based training technologies to enhance individual and small unit combat task proficiency and decision making.<br>***FY 2014 Plans:***<br>- Continue all efforts of FY 2013.<br>- Complete experimentation of simulation based training technologies to enhance individual and small unit combat task proficiency and decision making.<br>***FY 2015 Plans:***<br>- Continue all efforts of FY 2014, less those noted as completed above.<br>- Initiate development and assessment of modeling and simulation hardware, software, and training capabilities that support planning/experimentation processes. | | | |
| **Accomplishments/Planned Programs Subtotals** | 38.833 | 44.018 | 42.774 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603640M / *MC Advanced Technology Demo* | **Project (Number/Name)**<br>2297 / *Marine Corps Warfighting Lab - Core* |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**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-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | | | | | R-1 Program Element (Number/Name)<br>PE 0603651M *I JT Non-Lethal Wpns Tech Dev* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 10.179 | 11.853 | 11.506 | - | 11.506 | 12.745 | 13.117 | 13.448 | 13.387 | Continuing | Continuing |
| 3022: *Joint Non Lethal Weapons* | 0.000 | 10.179 | 11.853 | 11.506 | - | 11.506 | 12.745 | 13.117 | 13.448 | 13.387 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 Advanced Technology 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. 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-materiel missions; non-lethal counter-personnel technologies (acoustic, optical, and human electro-muscular disruption technologies), and advanced non-lethal materials (including materiels for vehicle/vessel stopping and counter-facility applications). 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 Commandant of the Marine Corps was 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, RDT&E Budget Item Justification: PB 2015 Navy | | | | | Date: March 2014 |
|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | | | R-1 Program Element (Number/Name)<br>PE 0603651M *I JT Non-Lethal Wpns Tech Dev* | | |
| **B. Program Change Summary ($ in Millions)** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO** | **FY 2015 Total** |
| Previous President's Budget | 11.706 | 11.854 | 12.108 | - | 12.108 |
| Current President's Budget | 10.179 | 11.853 | 11.506 | - | 11.506 |
| Total Adjustments | -1.527 | -0.001 | -0.602 | - | -0.602 |
| • Congressional General Reductions | - | -0.001 | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | - | - | | | |
| • SBIR/STTR Transfer | -0.448 | - | | | |
| • Rate/Misc Adjustments | - | - | -0.602 | - | -0.602 |
| • Congressional General Reductions Adjustments | -1.079 | - | - | - | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | R-1 Program Element (Number/Name)<br>PE 0603651M / *JT Non-Lethal Wpns Tech Dev* | Project (Number/Name)<br>3022 / *Joint Non Lethal Weapons* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3022: *Joint Non Lethal Weapons* | - | 10.179 | 11.853 | 11.506 | - | 11.506 | 12.745 | 13.117 | 13.448 | 13.387 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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-materiel missions; non-lethal counter-personnel technologies (acoustic, optical, and human electro-muscular disruption technologies), and advanced non-lethal materiels (including materiels 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.

The increase in the Joint Non-Lethal Weapons funding from FY 2013 to FY 2014 is due to the initiation and expanded evaluation of alternative non-lethal prototype technologies offering operational military utility with the goal of transitioning the best candidates to higher levels of technology development and acquisition.

The FY 2014 to FY 2015 decrease in the Joint Non-Lethal Weapons Technology Development PE is due to a funding reduction addressed in Deputy Secretary of Defense Memo, "Strategic Choices and Management Review Resulting Direction and Guidance". This reduction slows the advanced prototype development and demonstration of a smaller, lighter active denial technology demonstrator based on most promising and mature 95 GHZ source technology. It also delays the schedule of the modular prototyping of High Power Microwave (HPM) component hardware and defers initiation of behavior response research and analysis.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** JOINT NON-LETHAL WEAPONS | 10.179 | 11.853 | 11.506 |
| ***FY 2013 Accomplishments:***<br>- 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.<br>- Continued research to define and transition to higher levels of technology development the optimum approaches, technologies and tactics necessary to clear a facility/building with and without entry.<br>- Discontinued current 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, 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. Reevaluating approach. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603651M / *JT Non-Lethal Wpns Tech Dev* | **Project (Number/Name)**<br>3022 / *Joint Non Lethal Weapons* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - 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.<br>- Continued prototype development and transition to higher levels of technology development of advanced payloads for candidate technological capabilities with applications relevant to emerging capability gaps.<br>- Continued prototype development, demonstration, and transition to higher levels of technology development of the most promising candidate technologies addressing the extended range/duration incapacitation capability gap.<br>- Continued transition to higher levels of development and demonstration for the most promising candidate technologies employing multisensory stimuli.<br>- Continued to address non-lethal counter-personnel capability gaps with alternative directed energy technologies.<br>- Continued transition to higher levels of technology development and demonstrate the most promising directed energy technologies under consideration for counter-personnel and counter-materiel applications.<br>- Continued technology development employing optimized electro-muscular disruption waveforms and mechanisms for an extended duration counter-personnel suppression capability.<br>- Continued advanced prototype development and demonstration of a smaller, lighter active denial technology demonstrator based on most promising and mature 95 GHZ source technology.<br>- Completed integration of the Advanced Total Body Model into a suite of non-lethal effects modeling capability now referred to as the Human Effects Modeling and Analysis Program (HE-MAP) during FY11. Non-lethal effects characterization through modeling and effects testing continues using HE-MAP.<br>- Initiated evaluation of alternative non-lethal prototype technologies offering operational utility and transition best candidates to higher levels of technology development and acquisition. | | | |
| ***FY 2014 Plans:***<br>- Continue all efforts from FY2013, except those noted as completed.<br>- Initiate prototype concepts for an integrated combined effects demonstration platform to provide scalable escalation of force capability using an integrated, systems of systems approach.<br>- Initiate advanced system component research and development for integration into NLE systems (vehicle stopping, vessel stopping, and counter personnel systems). | | | |
| ***FY 2015 Plans:***<br>- Continue all efforts from 2014.<br>- Continue advanced prototype development and demonstration of a smaller, lighter active denial technology demonstrator based on the most promising and mature 95 GHz source technology. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603651M / *JT Non-Lethal Wpns Tech Dev* | **Project (Number/Name)**<br>3022 / *Joint Non Lethal Weapons* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue incorporation of suitable sensors capable of measuring NL stimuli into surrogate test models as part of the Human Effects Modeling Analysis Program (HEMAP).<br>- Initiate modular prototyping of High Power Microwave (HPM) component hardware meeting development objectives for subsequent integration into an HPM-capable system configuration. | | | |
| **Accomplishments/Planned Programs Subtotals** | 10.179 | 11.853 | 11.506 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**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, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | **R-1 Program Element (Number/Name)**<br>PE 0603673N *I (U)Future Naval Capabilities Advanced Tech Dev* |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Program Element | 0.000 | 254.987 | 252.836 | 256.144 | - | 256.144 | 263.891 | 263.917 | 268.649 | 268.641 | Continuing | Continuing |
| 3346: *Future Naval Capabilities Adv Tech Dev* | 0.000 | 225.653 | 247.836 | 256.144 | - | 256.144 | 263.891 | 263.917 | 268.649 | 268.641 | Continuing | Continuing |
| 9999: *Congressional Adds* | 0.000 | 29.334 | 5.000 | - | - | - | - | - | - | - | - | 34.334 |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

The efforts described in this Program Element (PE) address the Advanced Technology Development associated with the Future Naval Capabilities (FNC) Program. The FNC Program represents the requirements-driven, delivery-oriented portion of the Navy's Science and Technology (S&T) portfolio. FNC investments respond to Naval S&T Gaps that are identified by the Navy and Marine Corps after receiving input from Naval Research Enterprise (NRE) stakeholders. The Enabling Capabilities (ECs) and associated technology product investments of the FNC Program are competitively selected by a 3-star Technology Oversight Group (TOG), chartered by the S&T Corporate Board and representing the requirements, acquisition, research and fleet/forces communities of the Navy and the Marine Corps.

This was a new PE in FY 2013 that consolidated all Navy 6.3 FNC Program investments into a single Navy 6.3 PE. Marine Corps FNC 6.3 investments are consolidated in a single Marine Corps 6.3 PE (0603640M). In FY 2011 and FY 2012, the Navy's 6.3 FNC Program investments were spread across 8 separate 6.3 PEs: 0603114N, 0603123N, 0603235N, 0603236N, 0603271N, 0603279N, 0603747N and 0603782N. The consolidation in this PE allows all investments to be viewed by FNC Pillar, Enabling Capability (EC) and Technology Product. It greatly enhances the visibility of the FNC Program by providing an easily navigable overview of all 6.3 FNC investments in a single place.

| B. Program Change Summary ($ in Millions) | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 256.382 | 247.931 | 250.656 | - | 250.656 |
| Current President's Budget | 254.987 | 252.836 | 256.144 | - | 256.144 |
| Total Adjustments | -1.395 | 4.905 | 5.488 | - | 5.488 |
| • Congressional General Reductions | - | -0.095 | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | 5.000 | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | -1.072 | - | | | |
| • SBIR/STTR Transfer | -8.282 | - | | | |
| • Program Adjustments | - | - | 12.789 | - | 12.789 |
| • Rate/Misc Adjustments | -0.001 | - | -7.301 | - | -7.301 |

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | Date: March 2014 |
|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | | R-1 Program Element (Number/Name)<br>PE 0603673N *I (U)Future Naval Capabilities Advanced Tech Dev* | | | |
| • Congressional General Reductions | -24.040 | - | - | - | - |
| Adjustments | | | | | |
| • Congressional Add Adjustments | 32.000 | - | - | - | - |

**Congressional Add Details ($ in Millions, and Includes General Reductions)**

| | FY 2013 | FY 2014 |
|---|---|---|
| **Project:** 9999: *Congressional Adds* | | |
| Congressional Add: *ASW Research Prog - Cong* | - | 5.000 |
| Congressional Add: *Technology Transition* | 29.334 | - |
| Congressional Add Subtotals for Project: 9999 | 29.334 | 5.000 |
| Congressional Add Totals for all Projects | 29.334 | 5.000 |

**Change Summary Explanation**

Technical: Not applicable.
Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | R-1 Program Element (Number/Name)<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | Project (Number/Name)<br>3346 / *Future Naval Capabilities Adv Tech Dev* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3346: *Future Naval Capabilities Adv Tech Dev* | - | 225.653 | 247.836 | 256.144 | - | 256.144 | 263.891 | 263.917 | 268.649 | 268.641 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

FNC investments are typically 3-5 years in duration. They provide a continuance of basic research by maturing technologies from a Technology Readiness Level (TRL) of 3 or 4 to a TRL of 6. All FNC products require BA2 and BA3 funded technology development, which is coordinated to ensure tangible technology products are delivered upon completion of each investment. Each year the TOG refreshes the FNC Program by approving new ECs and technology products as older ones get delivered. After transition to an acquisition program, FNC products are further engineered, integrated and ultimately, delivered to the warfighter. The development and delivery of each FNC product is guided by a Technology Transition Agreement (TTA) that is signed by the requirements and acquisition sponsors, as well as the S&T developer.

This project supports the naval pillars of Capable Manpower, Enterprise and Platform Enablers, Expeditionary Maneuver Warfare, Force Health Protection, Forcenet, Power and Energy, Sea Basing, Sea Shield and Sea Strike. Each of these pillars is listed as a separate R-2 Activity. Under each R-2 Activity, the BA 6.3 accomplishments and plans for every Enabling Capability (EC) and Technology Product in the FNC Program are listed. ECs are composed of one or more interrelated technology products, so for clarity, each product is shown under its EC.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** CAPABLE MANPOWER (CMP) | 16.150 | 18.320 | 18.312 |
| ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Capable Manpower (CMP) FNC pillar. The CMP Pillar develops deliverable technologies that provide new capabilities in manpower and personnel management, training and education, and human-systems integration for more intuitive systems.<br><br>The FY 2013 to FY 2014 increase was due to the initiation of CMP-FY14-02 and the planned ramp-up of CMP-FY13-02.<br><br>***FY 2013 Accomplishments:***<br>EC: CMP-FY10-01 Information Architecture for Improved Decision Making<br>- Continue Data Triage - Conduct advanced development of mission performance optimizations that encompass task centered design and advanced human performance modeling to achieve the requisite manning, both in numbers and capabilities, for the complex ships and systems of the future fleet. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Display Information with Uncertainty - Develop a prototype with the capability to fuse imaging, electronic warfare, and inorganic and acoustic sensor inputs into integrated, fused, and intuitive displays that enhance the presentation and command level understanding of uncertain information.<br><br>EC: CMP-FY10-02 Adaptive Training to Enhance Individual and Team Learning and Performance<br>- Continue Adaptive Training for Combat Information Center Teams - Develop prototypes of effective, adaptive training system components to enhance individual and team training for surface ship Combat Information Center (CIC) training.<br>- Continue Adaptive Training for Submarine Navigation & Piloting Teams - Develop prototypes of effective, adaptive training system components to enhance individual and team training for submarine navigation and piloting skills training.<br><br>EC: CMP-FY11-01 Naval Next-generation Immersive Technology (N2IT)<br>- Continue Augmented Immersive Team Training (AITT) - Demonstrate software and hardware technologies to enable collective, immersive squad level infantry training without a fixed facility or role players.<br>- Continue Perceptual Training Systems and Tools (PercepTs) - Design and demonstrate the technology components to deliver combat/tactical perceptual training in relevant environments.<br><br>EC: CMP-FY11-02 Performance Shaping Functions for Environmental Stressors<br>- Continue Performance Shaping Functions - Develop and demonstrate environmental stressor metrics and algorithms, and integrate them into systems engineering tools.<br><br>EC: CMP-FY12-01 Live, Virtual, & Constructive Training Fidelity<br>- Continue Cognitive Fidelity Synthetic Environment - Conduct advanced development of optimal characteristics of virtual simulations to elicit the appropriate perceptual-cognitive responses for Naval aviation training.<br>- Continue Tactics & Speech Capable Semi-Automated Forces - Conduct advanced development of virtual-constructive representations on live avionics displays.<br>- Continue Virtual-Constructive Representations on Live Avionics Displays - Conduct advanced development of design guidelines for effective and safe representation of virtual and constructive assets on live displays, including developing the symbology used during experimentation and validation efforts.<br><br>EC: CMP-FY13-02 Simulation Toolset for Analysis of Mission, Personnel and Systems (STAMPS)<br>- Initiate/Complete Manpower Planning and Optimization Toolset - Conduct advanced development of a toolset for assessing manpower planning and allocations. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate Platform Design and Acquisition Toolset - Conduct advanced development of an acquisition toolset for assessing and comparing platform designs.<br><br>***FY 2014 Plans:***<br>EC: CMP-FY10-01 INFORMATION ARCHITECTURE FOR IMPROVED DECISION MAKING<br>- Complete Data Triage - 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.<br>- Complete Display Information with Uncertainty - Develop and demonstrate a submarine mission planning capability that reduces operator burden, provides flexibility to develop plans across different mission operations, and shifts the cognitive work of planners and command team reviewers from manual processes toward higher levels of critical-thinking.<br><br>EC: CMP-FY10-02 ADAPTIVE TRAINING TO ENHANCE INDIVIDUAL AND TEAM LEARNING AND PERFORMANCE<br>- Complete Adaptive Training for Combat Information Center Teams - Demonstrate adaptive training system technologies that enhance individual and team training for surface ship Combat Information Center personnel.<br>- Complete Adaptive Training for Submarine Navigation & Piloting Teams - Develop and demonstrate training diagnostic tools and measures to help ensure that individuals and teams training in the Integrated Submarine Piloting and Navigation/Submarine Bridge Trainer meet rigorous Navy standards.<br><br>EC: CMP-FY11-01 NAVAL NEXT-GENERATION IMMERSIVE TECHNOLOGY (N2IT)<br>- Continue Augmented Immersive Team Training (AITT) - Design and demonstrate the efficacy of a new virtual training architecture for urban and dense infrastructure environments.<br>- Continue Perceptual Training Systems and Tools (PercepTs) - Design, demonstrate, and evaluate the efficacy of new technologies for perceptual training.<br><br>EC: CMP-FY11-02 PERFORMANCE SHAPING FUNCTIONS FOR ENVIRONMENTAL STRESSORS<br>- Complete Performance Shaping Functions - Incorporate environmental stressors (fatigue, motion, vibration and extreme temperatures) into systems engineering tools.<br><br>EC: CMP-FY12-01 LIVE, VIRTUAL, & CONSTRUCTIVE TRAINING FIDELITY<br>- Continue Cognitive Fidelity Synthetic Environment - Design and develop virtual simulations that elicit the appropriate perceptual-cognitive responses for Naval aviation training.<br>- Continue Tactics & Speech Capable Semi-Automated Forces - Conduct advanced development of software that automatically generates doctrinally accurate semi-autonomous forces that are adaptive to training scenario events. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Virtual-Constructive Representations on Live Avionics Displays - Develop, test, and refine the Live, Virtual, & Constructive (LVC) symbology used during experimentation and validation efforts.<br><br>EC: CMP-FY13-02 SIMULATION TOOLSET FOR ANALYSIS OF MISSION, PERSONNEL AND SYSTEMS (STAMPS)<br>- Continue Platform Design and Acquisition Toolset - Develop a toolset that assesses the relationship between ship design and manpower during realistic missions and applications.<br><br>EC: CMP-FY14-02 UNMANNED AERIAL SYSTEMS INTERFACE, SELECTION AND TRAINING TECHNOLOGIES (U-ASISTT)<br>- Initiate Dynamic, Adaptive & Modular Training for Unmanned Aerial Systems (UAS) - Develop semi-automated forces knowledge structures.<br>- Initiate Selection for Unmanned Aerial Systems (UAS) Personnel (SUPer) - Construct specific unmanned aircraft system selection tests.<br>- Initiate Unmanned Aerial Systems (UAS) Control Station Human Machine Interface - Create display design options that address the information demands of unmanned aircraft system operators.<br>***FY 2015 Plans:***<br>EC: CMP-FY11-01 NAVAL NEXT-GENERATION IMMERSIVE TECHNOLOGY (N2IT)<br>- Complete Augmented Immersive Team Training (AITT) - Develop, integrate, and demonstrate hardware and software for Augmented Reality training for infantry operations.<br>- Complete Perceptual Training Systems and Tools (PercepTs) - Design, demonstrate, and evaluate the efficacy of new technologies for perceptual training.<br><br>EC: CMP-FY12-01 LIVE, VIRTUAL, & CONSTRUCTIVE TRAINING FIDELITY<br>- Continue Cognitive Fidelity Synthetic Environment - Design and develop virtual simulations that elicit the appropriate perceptual-cognitive responses for Naval aviation training.<br>- Continue Tactics & Speech Capable Semi-Automated Forces - Demonstrate software that automatically generates doctrinally accurate semi-autonomous forces that are adaptive to training scenario events.<br>- Continue Virtual-Constructive Representations on Live Avionics Displays - Test, evaluate, and refine the Live, Virtual, & Constructive (LVC) zymology used during experimentation and validation efforts.<br><br>EC: CMP-FY13-02 SIMULATION TOOLSET FOR ANALYSIS OF MISSION, PERSONNEL AND SYSTEMS (STAMPS)<br>- Continue Manpower Planning and Optimization Toolset - Develop total ownership cost measures and analytical techniques to evaluate proposed shipboard manpower and personnel requirements. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Platform Design and Acquisition Toolset - Develop a software toolset for evaluation of ship design and manpower configurations.<br><br>EC: CMP-FY14-02 UNMANNED AERIAL SYSTEMS INTERFACE, SELECTION AND TRAINING TECHNOLOGIES (U-ASISTT)<br>- Continue Dynamic, Adaptive & Modular Training for UAS - Design knowledge structures to support activity learning, scenario requirements to activities links, semi-automated forces envelope generation, cognitive modeling, generative semi-automated forces behaviors and integration with DoN simulation and training systems.<br>- Continue Selection for UAS Personnel (SUPer) - Construct unmanned aircraft operator selection and classification test batteries, including underlying data collection instruments within the DoN's APEX framework.<br>- Continue UAS Control Station Human Machine Interface - Create Common Control Station information display design specifications that focus on reducing the information demands placed on unmanned aircraft system operators.<br><br>EC: CMP-FY15-01 ACCELERATING DEVELOPMENT OF SMALL UNIT DECISION MAKERS (ADSUDM)<br>- Initiate Decision Making-Learning Management System (DM-LMS) - Define existing Marine Corps measures/standards of Decision Making (DM) and instructional method guidelines and develop software products to plan, assess, and track decision making skill development.<br>- Initiate Digital Integrated Representation of Tactical Environment (DIRTE) - Define existing Marine Corps CONOPS for classroom and sustainment training and develop rapid terrain modeling and sketchpad software products to enable small unit leaders and instructors to create effective decision making environments and scenarios.<br>- Initiate Simulation Tailored Training and Assessment (ST2A) - Define existing Marine Corps situated tutor techniques and unobtrusive monitoring techniques and develop software and hardware prototypes to execute decision making program of instruction and scenarios in simulation.<br><br>EC: CMP-FY15-02 ENVIRONMENT DESIGNED TO UNDERTAKE COUNTER A2AD TACTICS TRAINING & EXPERIMENTATION (EDUCAT2E)<br>- Initiate Environment Designed to Undertake Counter A2AD Tactics Training & Experimentation (EDUCAT2E) - Investigate and develop an approach to an objective, metrics-driven training and experimentation capability for Fast Attack Craft and Mine Warfare threats. | | | |
| ***Title:*** ENTERPRISE AND PLATFORM ENABLERS (EPE) | 35.663 | 33.470 | 18.423 |
| ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Enterprise and Platform Enablers (EPE) FNC pillar. The EPE Pillar develops cross-cutting, deliverable technologies that provide new capabilities for naval service platforms that lower acquisition, operations and maintenance costs, improve system safety and availability, and improve platform survivability. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

The FY 2013 to FY 2014 decrease was primarily due to the completion of EPE-FY09-03 and the planned ramp-down of EPE-FY08-08, EPE-FY09-07 and EPE-FY11-01.

The FY 2014 to FY 2015 decrease was due to the completion of EPE-FY09-01 and EPE-FY10-02, and the planned ramp-down of EPE-FY10-01 and EPE-FY10-03.

***FY 2013 Accomplishments:***
EC: EPE-FY07-02 Maritime Prepositioning Force Future Marine Expeditionary Brigade Force Closure
- Continue 38 MW Axial-Flow Waterjet - Conduct Maritime Pre-Positioning Force Future (MPF-F) final at-sea demo of the Axial-Flow Waterjet on the Littoral Combat Ship (LCS).

EC: EPE-FY08-08 Turbine Engine Reduced Cost of Operations 2
- Complete Turbine Engine Technology Demonstrations (Engines) - Finish detail design, initiate long-lead hardware procurement and start engine fabrication for the XTE69/LFU1 durability demonstrator engine (F-135 based).
- Complete Turbine Engine Technology Demonstrations (Materials) - Conduct materials research for aviation engines.

EC: EPE-FY09-01 Affordable Common Radar Architecture
- Continue Affordable Common Radar Architecture - Develop, fabricate, integrate and test a low cost surface radar replacement system.

EC: EPE-FY09-03 Air Platforms Safety and Affordability Technologies
- Complete Adaptive Expert System for the Autonomous Detection of Aviation Mishap Leading Indicators - Develop and validate adaptive expert system requisite analytical techniques using flight data from Fleet aircraft
- Complete Advanced Rotor Blade Erosion Protection - Demonstrate erosion-resistant coatings.

EC: EPE-FY09-07 Affordable Submarine Propulsion and Control Actuation
- Continue Advanced Material Propeller - Develop the structural design and prototype multiple pitch-adapting composite blades, hubs, and propellers culminating in large-scale manufacture of prototype propellers.

EC: EPE-FY10-01 Advanced Shipboard Water Desalination
- Continue Desalination System - Develop, fabricate and test desalination system demonstrators.
- Continue Pretreatment System - Develop, fabricate and test seawater pretreatment system demonstrators.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: EPE-FY10-02 Affordable Modular Panoramic Photonics Mast<br>- Continue Compact Hyper-spectral Scanning Imager - Develop, fabricate and test hyperspectral sensors and algorithms to improve SSN surface situational awareness using faster image acquisition rates.<br>- Continue Compact Low Light Level Short Wave Infrared (SWIR) Video Camera - Develop, fabricate and test Shortwave infrared sensors and algorithms to improve SSN surface situational awareness using faster image acquisition rates.<br>- Continue Modular Photonics Mast Housing - Conduct integration and test of Short Wave Infrared (SWIR) sensors into a SSN/ SSGN photonics mast for improved surface situational awareness and autonomous detection and classification.<br><br>EC: EPE-FY10-03 Corrosion and Corrosion Related Signature Technologies for Increased Operational Availability<br>- Continue Advanced Active Shaft Grounding System (ASGS)/Shaft Current Sensor - Evaluate, design and demonstrate an advanced active shaft grounding system with condition based maintenance and signature control.<br>- Continue Advanced-Robust Impressed Current Cathodic Protection (ICCP) Anodes and Reference Cells - Evaluate, design, and conduct large scale testing and demonstration of impressed current cathodic protection components.<br>- Continue Dual-Use Corrosion/Signature Sensor for Ballast Tanks - Evaluate, design and demonstrate dual-use impressed current cathodic protection and novel sensor technology for condition based maintenance and closed-loop deamping.<br><br>EC: EPE-FY11-01 Flight Deck Thermal Management<br>- Complete Advanced Thermal Management System - Integrate and test a large-scale thermal management system.<br>- Continue Integrated Thermal Management System Design - Conduct land-based testing of large-scale thermal management system panels and modifications as necessary.<br><br>EC: EPE-FY12-01 Corrosion Mitigation Technologies and Design Integration<br>- Continue Corrosion Resistant Surface Treatment - Conduct scale up of interstitial hardening to large bulk components for application on surface combatant propulsion materials.<br>- Continue Sprayable Acoustic Damping Systems - Test and evaluate new sprayable acoustic damping coatings system to characterize corrosion and acoustic damping properties.<br><br>EC: EPE-FY12-02 Integrated Hybrid Structural Management System (IHSMS)<br>- Continue Distributed Structural Micro-Sensor Nodes - Conduct research in wireless energy harvesting sensors, architecture, and diagnostics for rotorcraft structural health management.<br>- Continue Rotor - Hot Spot Sensors and Integration - Demonstrate structural health monitoring rotor-hot spot sensors and integration technologies for rotary wing vehicles. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: EPE-FY13-01 Towed Array System Reliability Improvement<br>- Initiate Tools for Predicting Array Operational Loading and Distribution - Develop a methodology for applying modeling tools in a towed array system design to produce an accurate prediction of system reliability and test a subset of towed array components, or modules, as suggested by failure data, existing design limitations, and newly developed reliability models. | | | |
| ***FY 2014 Plans:***<br>EC: EPE-FY07-02 Maritime Prepositioning Force Future Marine Expeditionary Brigade Force Closure<br>- Complete 38 MW Axial-Flow Waterjet - Conduct Maritime Pre-Positioning Force Future (MPF-F) final at-sea demo of the Axial-Flow Waterjet on the Littoral Combat Ship (LCS).<br><br>EC: EPE-FY08-08 Turbine Engine Reduced Cost of Operations 2<br>- Complete Turbine Engine Technology Demonstrations (Engines) - Finish detail design, initiate long-lead hardware procurement and start engine fabrication for the XTE69/LFU1 durability demonstrator engine (F-135 based).<br><br>EC: EPE-FY09-01 AFFORDABLE COMMON RADAR ARCHITECTURE<br>- Continue Affordable Common Radar Architecture - Demonstrate final test objective architecture-compliant advanced development model in a relevant environment.<br><br>EC: EPE-FY09-07 AFFORDABLE SUBMARINE PROPULSION AND CONTROL ACTUATION<br>- Continue Advanced Material Propeller - Design and fabricate an Advanced Material Propeller (AMP) and conduct a structural performance evaluation of Generation 1 full-scale prototype composite blades, scale hub and root block.<br><br>EC: EPE-FY10-01 ADVANCED SHIPBOARD WATER DESALINATION<br>- Continue Advanced Navy Reverse Osmosis System (formerly known as both Desalination System and Pretreatment System) - Develop, fabricate and test desalination seawater pretreatment system demonstrators.<br><br>EC: EPE-FY10-02 AFFORDABLE MODULAR PANORAMIC PHOTONICS MAST<br>- Complete Compact Hyper-spectral Scanning Imager - Demonstrate a prototype camera in a Mast Test Vehicle (MTV) in a relevant at-sea environment.<br>- Complete Compact Low Light Level Short, Wavelength Infrared (SWIR) Video Camera - Demonstrate a Low Light Level Short, Wavelength Infrared (SWIR) Video Camera in a Mast Test Vehicle (MTV) in a relevant at-sea environment.<br>- Complete Modular Photonics Mast Housing - Demonstrate the Modular Photonics Mast Housing and Panoramic Headwindow in a Mast Test Vehicle (MTV) in a relevant at-sea environment. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: EPE-FY10-03 CORROSION AND CORROSION RELATED SIGNATURE TECHNOLOGIES FOR INCREASED OPERATIONAL AVAILABILITY<br>- Complete Advanced Active Shaft Grounding System (ASGS)/Shaft Current Sensor - Design system and complete full scale demonstration.<br>- Complete Dual-Use Corrosion/Signature Sensor for Ballast Tanks - Design system and complete full scale demonstration.<br>- Continue Advanced-Robust Impressed Current Cathodic Protection (ICCP) Anodes and Reference Cells - Conduct large scale testing with selected Impressed Current Cathodic Protection (ICCP) components.<br><br>EC: EPE-FY11-01 FLIGHT DECK THERMAL MANAGEMENT<br>- Continue Integrated Thermal Management System Design - Integrate panels to ship deck and initiate selection of ship test bed to resolve final integration issues.<br><br>EC: EPE-FY12-01 CORROSION MITIGATION TECHNOLOGIES<br>- Continue Corrosion Resistant Surface Treatment - Process scaled components for testing.<br>- Continue Sprayable Acoustic Damping Systems - Demonstrate promising damping systems on mockup structures and selected small scale platform.<br><br>EC: EPE-FY12-02 INTEGRATED HYBRID STRUCTURAL MANAGEMENT SYSTEM (IHSMS)<br>- Continue Distributed Structural Micro-Sensor Nodes - Develop and demonstrate the technology feasibility of a distributed sensor architecture with diagnostic and prognostic capability for rotorcraft structural health management.<br>- Continue Rotor - Hot Spot Sensors and Integration - Demonstrate structural health monitoring rotor-hot spot sensors and integration technologies for rotary wing vehicles.<br><br>EC: EPE-FY13-01 TOWED ARRAY SYSTEM RELIABILITY IMPROVEMENT<br>- Continue Tools for Predicting Array Operational Loading & Distribution - Build functionality to improve the model, ensuring operability as its complexity and fidelity increase.<br><br>EC: EPE-FY14-02 ALUMINUM ALLOY CORROSION CONTROL AND PREVENTION<br>- Initiate Aluminum Alloy Corrosion Mitigation Technologies - Evaluate commercial and near-commercial technologies for re-solutionizing Magnesium precipitates on Al 5XXX alloys.<br>- Initiate Aluminum Alloy Corrosion Prediction Tool - Evaluate and select Degree of Sensitization (DoS) detectors.<br>***FY 2015 Plans:***<br>EC: EPE-FY09-01 Affordable Common Radar Architecture | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete Affordable Common Radar Architecture - Develop, fabricate, integrate and test a low cost surface radar replacement system.<br><br>EC: EPE-FY09-07 AFFORDABLE SUBMARINE PROPULSION AND CONTROL ACTUATION<br>- Complete Advanced Material Propeller - Assess blade/hub joint strength, perform blade fatigue and deflection testing, and static and dynamic testing of the complex hub unit.<br><br>EC: EPE-FY10-01: ADVANCED SHIPBOARD WATER DESALINATION<br>- Complete Advanced Navy Reverse Osmosis System - Demonstrate robust reverse osmosis based water purification systems on ship platforms.<br><br>EC: EPE-FY10-03 CORROSION AND CORROSION RELATED SIGNATURE TECHNOLOGIES FOR INCREASED OPERATIONAL AVAILABILITY<br>- Complete Advanced-Robust ICCP Anodes and Reference Cells - Complete reference cell laboratory performance testing and down select.<br><br>EC: EPE-FY12-01 CORROSION MITIGATION TECHNOLOGIES<br>- Continue Corrosion Resistant Surface Treatment - Complete development of single step treatment.<br>- Continue Sprayable Acoustic Damping Systems - Complete corrosion testing of prototype Sprayable Acoustic Damping system.<br><br>EC: EPE-FY12-02 INTEGRATED HYBRID STRUCTURAL MANAGEMENT SYSTEM (IHSMS)<br>- Continue Distributed Structural Micro-Sensor Nodes - Conduct research in wireless energy harvesting sensors and other advanced sensors, architectures, diagnostics and prognostics technologies for rotorcraft structural health management.<br>- Continue Rotor - Hot Spot Sensors and Integration - Evaluate and optimize rotor-hot spot sensors and integration technologies that allow improved health assessment of rotating frame and selected structural hot spots.<br><br>EC: EPE-FY13-01 TOWED ARRAY SYSTEM RELIABILITY IMPROVEMENT<br>- Continue Tools for Predicting Array Operational Loading & Distribution - Develop individual predictive models for hydrodynamic effects on a towed array that include the forces imparted on a towed array by the handling system and the effects of the combined forces on array internal components.<br><br>EC: EPE-FY14-02 ALUMINUM ALLOY CORROSION CONTROL AND PREVENTION<br>- Continue Aluminum Alloy Corrosion Mitigation Technologies - Continue coating formulation and evaluate properties. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Aluminum Alloy Corrosion Prediction Tool - Develop algorithm for 5000 series aluminum alloy degree of sensitization and for prediction of Mean Time to Repair.<br><br>EC: EPE-FY15-02 GAS TURBINE UPGRADES FOR REDUCED TOTAL OWNERSHIP COST (TOC) AND IMPROVED SHIP IMPACT<br>- Initiate Shipboard Gas Turbine Marinization Package for Higher Temperature, Higher Pressure Operation - Conduct Navy gas turbine hot corrosion analysis and experimentation under shipboard environmental conditions and power scales.<br><br>EC: EPE-FY15-03 SPECIAL HULL TREATMENT<br>- Continue New Material(s) Development & Lab Characterization - Develop new materials mitigation technology for submarines. | | | |
| ***Title:*** EXPEDITIONARY MANEUVER WARFARE (EMW) | 6.101 | 9.074 | 8.742 |
| ***Description:*** This R-2 Activity contains the Navy funded Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Expeditionary Maneuver Warfare (EMW) FNC Pillar. The EMW Pillar develops deliverable technologies that provide new capabilities in expeditionary maneuver warfare, including naval ground forces, with special emphasis on regular and irregular warfare in urban environments and combating terrorism.<br><br>The FY 2013 to FY 2014 increase was due primarily to the initiation of EMW-FY14-01 and the planned ramp-up of EMW-FY13-01.<br><br>***FY 2013 Accomplishments:***<br>EC: EMW-FY12-02 Future Joint Counter Radio-Controlled IED Electronic Warfare (JCREW)<br>- Continue Distributed Counter-Radio Controlled Improvised Explosive Device (C-RCIED) - Develop, fabricate and test network data links and message sets for coordinated distributed counter-radio controlled improvised explosive device resources.<br>- Continue Integrated Counter-RCIED EW (ICEW) - Develop, fabricate and test counter-radio controlled improvised explosive device demonstrators.<br><br>EC: EMW-FY13-01 Azimuth and Inertial MEMS Navigation System<br>- Initiate MEMS Inertial Navigation System - Design, fabricate and demonstrate a full navigation system for hand-held targeting systems that will reduce target location error.<br><br>***FY 2014 Plans:***<br>EC: EMW-FY12-02 FUTURE JOINT COUNTER RADIO-CONTROLLED IMPROVISED EXPLOSIVE DEVICE ELECTRONIC WARFARE (JCREW) | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Distributed Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (D-JCREW) - Develop implementation of a blue force communication network, tasking architecture and efficient data exchange for coordinating distributed Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare ( JCREW) platforms.<br>- Continue Integrated Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (I-JCREW) - Develop the subsystems for an integrated, next generation Electronic Warfare (EW) system for countering improvised explosive devices.<br><br>EC: EMW-FY13-01 AZIMUTH AND INERTIAL MICRO-ELECTRO-MECHANICAL SYSTEM (MEMS) NAVIGATION SYSTEM<br>- Complete Micro-Electro-Mechanical (MEMS) Inertial Navigation System - Design, fabricate and demonstrate a full navigation system for hand-held targeting systems that will reduce target location error.<br><br>EC: EMW-FY14-01 SPECTRAL AND RECONNAISSANCE IMAGERY FOR TACTICAL EXPLOITATION (SPRITE)<br>- Initiate Automated Processing for Spectral Exploitation and Dissemination (APSED) - Demonstrate cross-cueing between existing wide-area search detections Electro-Optical and Hyper-Spectral Imagery and collection of inspection Red, Green, Blue and Hyper-Spectral Imagery.<br>- Initiate Compact Wide Area Reconnaissance and Spectral Sensor (CWARSS) - Demonstrate a baseline for automated processing for spectral exploitation and dissemination.<br>***FY 2015 Plans:***<br>EC: EMW-FY12-02 FUTURE JOINT COUNTER RADIO-CONTROLLED IED ELECTRONIC WARFARE (JCREW)<br>- Continue Distributed Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (D-JCREW) - Develop distributed resource allocation and RF situational awareness techniques to provide automated tactical-level distributed jamming on multiple ground-based EW systems.<br>- Continue Integrated Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (I-JCREW) - Develop components and techniques to enable simultaneous transmission and reception of EW and blue-force communication waveforms.<br><br>EC: EMW-FY14-01 SPECTRAL AND RECONNAISSANCE IMAGERY FOR TACTICAL EXPLOITATION (SPRITE)<br>- Continue Automated Processing for Spectral Exploitation and Dissemination (APSED) - Conduct a feasibility effort to develop an Electro-Optical (EO) and Hyper-Spectral Imagery (HSI) image processing architecture that includes EO-to-HSI cross-correlation and fusion, image archiving and retrieval, and exploitation product generation.<br>- Continue Compact Wide Area Reconnaissance and Spectral Sensor (CWARSS) - Complete preliminary hardware design for a wide-area intelligence, surveillance and reconnaissance capability with simultaneous high spatial and spectral resolution. | | | |
| ***Title:*** FORCE HEALTH PROTECTION (FHP) | 15.758 | 14.818 | 15.623 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|

***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Force Health Protection (FHP) FNC pillar. The FHP Pillar develops deliverable technologies that provide new capabilities that provide Sailors and Marines with the best possible protection from operational threats by reducing morbidity and mortality when casualties occur.

***FY 2013 Accomplishments:***

EC: FHP-FY08-01 Casualty Prevention
- Complete Models of Head and Cervical Spine - Incorporate animal and post-mortem human specimen data into a finite element model for injury prediction.

EC: FHP-FY08-02 Advanced Forward Care
- Complete Closed Loop Fluid Delivery System - Integrate software algorithms and hardware and perform FDA tests/trials as required.
- Complete Non-Pulmonary Oxygenation - Integrate the hydrogen-peroxide catalyses into a low pressure container that meets air certification and FDA requirements.

EC: FHP-FY08-03 Rapid Blood Treatment
- Complete Hemostatic Agents - Conduct physiological testing of the efficacy of hemostatic materials in stopping hemorrhage in animal models.
- Complete Pharmacologic Resuscitation - Compare low-volume resuscitation with histone deacetylase inhibitors versus 'standard of care' in animals.

EC: FHP-FY08-04 Warfighter Restoration
- Complete Wound Healing - Develop a drug that targets the appropriate myostatin receptor through the most effective delivery route.
- Complete Hearing Loss Prevention and Treatment - Develop methodologies, standards and technologies for personal in-ear noise dosimeters and inner ear scanning for production of personal hearing protection.
- Complete Post Traumatic Stress Mitigation - Develop prototype devices and training methodologies for the mitigation of fatigue and combat stress.
- Complete Repetitive Neurotrauma Mitigation - Develop pharmacological treatments against the biological substrates of mild Traumatic Brain Injury (mTBI).

EC: FHP-FY10-01 Human Injury & Treatment Model

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Human Injury & Treatment Model - Conduct advanced development to assess personnel survivability, optimal personnel treatment, and restoration of ship operational capabilities.<br><br>EC: FHP-FY11-01 Multifunctional Blood Substitute (MFBS)<br>- Continue Multifunctional Blood Substitute (MFBS) - Develop a multi-component, complete, and shelf-stable resuscitation fluid.<br><br>EC: FHP-FY12-01 Automated Critical Care System (ACCS)<br>- Continue Automated Critical Care System (ACCS) - Integrate software algorithms and hardware and perform FDA tests/trials as required.<br><br>EC: FHP-FY12-02 Saving lives with Emergency Medical Perfluorocarbons in the Field (SEMPer Fi) for Sea, Air & Land Dysoxia<br>- Continue SEMPer Fi for Air Dysoxia - Conduct preclinical evaluation of potential therapeutics for immediate treatment of pulmonary hypoxia/hypoxemia.<br>- Continue SEMPer Fi for Land Blast Kit - Conduct preclinical evaluation of potential therapeutics for immediate treatment of blast overpressure, including injury to the brain and internal organs.<br><br>EC: FHP-FY13-03 Extreme Operations: Mitigating Oxygen Imbalance at Altitude and at Depth<br>- Initiate Hypoxia Alert and Mitigation System - Develop a hypoxia alert system that can mitigate conditions associated with a hypoxic environment based on individual susceptibility to performance decrements in hypoxic conditions. | | | |
| ***FY 2014 Plans:***<br>EC: FHP-FY10-01 HUMAN INJURY & TREATMENT MODEL<br>- Complete Human Injury & Treatment Model - Complete advanced development to deliver and transition the integrated model for predicting human injury, incapacitation, and medical response requirements associated with blast events in shipboard environments.<br><br>EC: FHP-FY11-01 MULTIFUNCTIONAL BLOOD SUBSTITUTE (MFBS)<br>- Continue Multifunctional Blood Substitute (MFBS) - Formulate a multi-component, complete, and shelf-stable resuscitation fluid.<br><br>EC: FHP-FY12-01 AUTOMATED CRITICAL CARE SYSTEM (ACCS)<br>- Continue Automated Critical Care System (ACCS) - Integrate software algorithms and hardware and perform Food and Drug Administration (FDA) tests/trials as required. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: FHP-FY12-02 SAVING LIVES WITH EMERGENCY MEDICAL PERFLUOROCARBONS IN THE FIELD (SEMPER FI) FOR SEA, AIR & LAND DYSOXIA<br>- Continue Saving Lives with Emergency Medical Perfluorocarbons in the Field (SEMPer Fi) for Air Dysoxia - Perform advanced studies for documentation required for initial Food and Drug Administration meeting for treatment of pulmonary hypoxia/ hypoxemia.<br>- Continue Saving Lives with Emergency Medical Perfluorocarbons in the Field (SEMPer Fi) for Land Blast Kit - Perform studies for documentation required for initial Food and Drug Administration (FDA) meeting for immediate treatment of blast overpressure, including injury to the brain and internal organs.<br><br>EC: FHP-FY13-03 EXTREME OPERATIONS: MITIGATING OXYGEN IMBALANCE AT ALTITUDE AND AT DEPTH<br>- Continue Hypoxia Alert and Mitigation System - Evaluate and adapt hypoxia alert system hardware/software with Human Systems Integration (HSI) considerations.<br><br>EC: FHP-FY14-01 ACUTE CARE COVER FOR SEVERELY INJURED LIMBS (ACCSIL)<br>- Initiate Acute Care Cover for Severely Injured Limbs (ACCSIL) - Develop test design for animal pharmaceutical efficacy studies and begin to develop materials to meet military suitability requirements.<br><br>EC: FHP-FY14-03 BLAST LOAD ASSESSMENT: SENSE AND TEST (BLAST)<br>- Initiate Algorithm - Begin development of test criteria for 'beta' algorithm.<br>- Initiate Neuro-Functional Assessment Tool - Begin development of neuro-cognative assessment tool subsystems, and begin test design for prototype.<br>- Initiate Sensor - Begin test design in order to validate and develop sensor data inputs. | | | |
| ***FY 2015 Plans:***<br>EC: FHP-FY11-01 MULTIFUNCTIONAL BLOOD SUBSTITUTE (MFBS)<br>- Continue Multifunctional Blood Substitute (MFBS) - Formulate a resuscitation fluid that provides volume expansion and improves clotting in hemorrhaging combat casualties.<br><br>EC: FHP-FY12-01 AUTOMATED CRITICAL CARE SYSTEM<br>- Continue Automated Critical Care System (ACCS) - Formulate autonomous hardware and software system to monitor and maintain combat causalities with minimal human intervention during a 2-6 hour Casualty Evacuation (CASEVAC) scenario.<br><br>EC: FHP-FY12-02 SAVING LIVES WITH EMERGENCY MEDICAL PERFLUOROCARBONS IN THE FIELD (SEMPER FI) FOR SEA, AIR & LAND DYSOXIA | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete SEMPer Fi for Air Dysoxia - Perform down-select of candidate drugs based on small and large animal testing for treatment of pulmonary hypertension.<br>- Continue SEMPer Fi for Land Blast Kit - Determine window of therapeutic intervention and dosing with hypothermia for immediate treatment of blast overpressure in small and large animals, including injury to the brain and/or internal organs.<br><br>EC: FHP-FY13-03 EXTREME OPERATIONS: MITIGATING OXYGEN IMBALANCE AT ALTITUDE AND AT DEPTH<br>- Continue Hypoxia Alert and Mitigation System - Test algorithms to detect/predict onset of hypoxia or hypoxia-like symptoms for mountain operators, casualties, and aviators.<br><br>EC: FHP-FY14-01 ACUTE CARE COVER FOR SEVERELY INJURED LIMBS (ACCSIL)<br>- Continue Acute Care Cover for Severely Injured Limbs (ACCSIL) - Establish efficacy test parameters for a fieldable wound cover to include novel outer cover materials and internal pharmaceutical coating that improve the clinical outcome of severe wounds.<br><br>EC: FHP-FY14-03 BLAST LOAD ASSESSMENT: SENSE AND TEST (BLAST)<br>- Continue Algorithm - Determine, establish and design test parameters for an algorithm that integrates blast intensity data with cognitive impairment data to predict likelihood of brain injury after a given blast event.<br>- Continue Neuro-Functional Assessment Tool - Establish testing paradigm and sensory modality for a non-psychometric device that detects and estimates severity of traumatic brain injury.<br>- Continue Sensor - Develop metrics for a self powered blast sensor that detects and quantifies acceleration, pressure, and impulse from a given blast event and outputs the data electronically. | | | |
| ***Title:*** FORCENET (FNT)<br><br>***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Forcenet (FNT) FNC Pillar. The FNT pillar develops deliverable technologies that provide new capabilities in Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), networking, navigation, sensors, decision support, cyber-space, intelligence, and space technologies that will provide the architectural framework for naval warfare in the information age.<br><br>The FY 2013 to FY 2014 increase was due primarily to the initiation of FNT-FY14-02 and FNT-FY14-03, and the planned ramp-up of FNT-FY10-03, FNT-FY12-02 and FNT-FY13-01.<br><br>The FY 2014 to FY 2015 decrease was due primarily to the completion of FNT-FY10-01 and the planned ramp-down of FNT-FY11-01 and FNT-FY11-02. | 47.555 | 55.884 | 53.454 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***FY 2013 Accomplishments:***<br>EC: FNT-FY08-05 Global War on Terror (GWOT) Focused Tactical Persistent Surveillance<br>- Complete Communications Enhancements for Tactical Sensors - Test and demonstrate a full field-of-view Intelligence-Surveillance-Reconnaissance (ISR) Tactical Reachback Capability.<br><br>EC: FNT-FY09-02 Dynamic Tactical Communications Networks<br>- Complete Assured Information Exchange - Mature and demonstrate strict priority queuing, adaptive routing and route control agent capabilities in trial events.<br>- Complete Self-Organizing Networks - Mature and demonstrate policy-based network management, mobile adhoc networking routing enhancements, radio-router interfaces, and dynamic routing across in-line network encrypters in trial events.<br><br>EC: FNT-FY09-04 Dynamic Command and Control (C2) for Tactical Forces and Maritime Operations Center (MOC)<br>- Complete Dynamic C2 for Tactical Forces and Maritime Operations Center (MOC) - Develop real-time algorithms for the automated sharing of information between command and control and combat systems involving Surface Navy combat system open architecture and Service Oriented Architecture (SOA) capabilities within disconnected, intermittent and limited networks .<br><br>EC: FNT-FY10-01 High-bandwidth Free-space Lasercomm<br>- Complete Free-space Optical Terminal (FOT) - Develop, fabricate, test, and demonstrate an active optical communication system.<br>- Complete Modulating Retro-reflector Unit (MRU) - Develop, fabricate, test, and demonstrate a passive optical communication system.<br><br>EC: FNT-FY10-02 Actionable Intelligence Enabled by Persistent Surveillance<br>- Continue Autonomous UAV Collision Avoidance System - Develop, fabricate and test a light weight, low cost sensor suite and autonomy algorithms to enable detection and avoidance of all classes of aircraft or Unmanned Aerial Vehicles.<br>- Continue Operational Adaptation Enterprise Services - Design and demonstrate an end-to-end system prototype tactical enterprise service bus that provides tools that exposes hidden enemy networks, an information enterprise, and application services for hybrid complex operations.<br>- Continue Ultra Wide Field-of-View (FOV) Area Surveillance System - Develop, fabricate and test unmanned aerial vehicle deployable, wide and narrow field-of-view electro-optic / infrared sensor payloads for persistent surveillance missions.<br><br>EC: FNT-FY10-03 SATCOM Vulnerability Mitigation | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Airborne Communications Suite (ACS) - Develop new open architecture radio and system level components and integrate these components with previously developed high performance apertures and programmable radios into a high bandwidth, airborne networking infrastructure that is resistant to interference and can support all tactical activities.<br><br>EC: FNT-FY11-01 Pro-Active Computer Network Defense and Information Assurance<br>- Continue Common Operational Security Decision System - Develop real-time, network data fusion and correlation algorithms for mining critical security events in order to detect, identify, and remediate nation state sponsored activities.<br>- Continue Next Generation Security and Security Management Protocols - Develop real-time, network-based security reconfiguration and management protocols for enterprise components.<br>- Continue Next Generation Sensors and Gateways - Develop real-time, flow control algorithms to monitor network traffic and detect illegal transactions.<br><br>EC: FNT-FY11-02 Fast Magic<br>- Continue Fast Magic Product 1 - Develop real-time algorithms. (details classified)<br>- Continue Fast Magic Product 2 - Develop real-time algorithms. (details classified)<br><br>EC: FNT-FY11-05 NRL Space<br>- Continue Multi-INT Tracking - Develop real-time fusion algorithms to detect and track maritime vessels.<br>- Continue Tagging - Develop real-time algorithms for data tags based on key parametric values used in the maritime environment.<br><br>EC: FNT-FY12-01 Advanced Tactical Data Link (ATDL)<br>- Continue Mission Based Waveform Controls & Networking - Mature, test, and demonstrate waveform controls and networking capabilities in trial events.<br><br>EC: FNT-FY12-02 Autonomous Persistent Tactical Surveillance<br>- Continue Autonomous Information-Based Surveillance Control - Develop, integrate and test software for information based collection planning aboard unmanned aerial vehicles.<br>- Continue Contextual Enterprise Information - Develop real-time enterprise exploitation algorithms and services to provide relevant target information extracted from Information Operations (IO) collection efforts to provide context-based services to augment Intelligence-Surveillance-Reconnaissance (ISR) sensor exploitation and analysis.<br>- Continue Mobile Autonomous Intelligence Surveillance Reconnaissance (ISR) to Command and Control (C2) Synchronization<br>- Design and demonstrate an enterprise distributed software system that will manage complex event processing and ensure that the ISR to C2 synchronization is maintained. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: FNT-FY13-01 EW Battle Management for Surface Defense<br>- Initiate EW Battle Management (EWBM) - Develop, fabricate and test electronic warfare data exchange techniques for Blue Force communication links in support of electronic warfare battle management.<br><br>EC: FNT-FY13-04 Detection and Fusion for Remote Sensors<br>- Initiate Adaptive Multi-INT Correlation & Identification (AMICA) - Develop algorithms to exploit multi-INT correlation capabilities between emerging Information Operations (IO) and new sensors at the tactical level.<br>- Initiate Detection & Classification Algorithms (DCA) - Conduct Advanced Research to develop detection and classification algorithms. | | | |
| ***FY 2014 Plans:***<br>EC: FNT-FY10-02 ACTIONABLE INTELLIGENCE ENABLED BY PERSISTENT SURVEILLANCE<br>- Complete Autonomous Unmanned Aerial Vehicle (UAV) Collision Avoidance System - Demonstrate autonomous collision avoidance system performance for all classes of aircraft or Unmanned Aerial Vehicles (UAV) in the National Airspace System (NAS).<br>- Complete Operational Adaptation Enterprise Services - Design and demonstrate an end-to-end system prototype tactical enterprise service bus that provides tools that expose hidden enemy networks, an information enterprise, and application services for hybrid complex operations.<br>- Continue Ultra Wide Field of View (FOV) Area Surveillance System - Develop and integrate flight-test optical hardware and image processing software into a prototype payload assembly.<br><br>EC: FNT-FY10-03 SATELLITE COMMUNICATIONS (SATCOM) VULNERABILITY MITIGATION<br>- Complete Multi-Link Common Data Link (CDL) System - Complete system integration and demonstration of a Multi-Link Common Data Link (CDL) System.<br><br>EC: FNT-FY11-01 PRO-ACTIVE COMPUTER NETWORK DEFENSE AND INFORMATION ASSURANCE<br>- Continue Common Operational Security Decision System - Develop implementation of a network security policy management engine to support automated policy discovery as well as human-driven policy origination and deployment.<br>- Continue Next Generation Security and Security Management Protocols - Develop implementation of a secure asynchronous mesh with context-aware path selection to support secure collaboration amongst Computer Network Defense platforms.<br>- Continue Next Generation Sensors and Gateways - Develop implementation of programmable hardware-accelerated network data extraction and identification system. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: FNT-FY11-02 FAST MAGIC<br>- Continue Fast Magic Product 1 - Develop real-time algorithms (details classified).<br>- Continue Fast Magic Product 2 - Develop real-time algorithms (details classified).<br><br>EC: FNT-FY11-05 NRL SPACE<br>- Continue Multi-INT Tracking - Develop real-time fusion algorithms and visualization techniques to detect, track and visualize current and historical maritime vessel track data.<br>- Continue Tagging - Develop real-time data tagging algorithms utilizing key parametric values used in the Maritime environment.<br><br>EC: FNT-FY12-01 ADVANCED TACTICAL DATA LINK (ATDL)<br>- Continue Mission-Based Waveform Controls & Networking - Complete a bench prototype for initial testing.<br><br>EC: FNT-FY12-02 AUTONOMOUS PERSISTENT TACTICAL SURVEILLANCE<br>- Continue Autonomous Information-Based Surveillance Control - Demonstrate and continue development of unmanned aerial vehicles information collection and retasking.<br>- Continue Contextual Enterprise Information - Adapt the analytical services framework for transition by developing real-time enterprise exploitation algorithms.<br>- Continue Mobile Autonomous Intelligence, Surveillance, Reconnaissance (ISR) to Command and Control (C2) Synchronization<br>- Design and demonstrate an enterprise distributed software system that will manage complex event processing and ensure that the Intelligence, Surveillance, Reconnaissance (ISR) to Command and Control (C2) synchronization is maintained.<br><br>EC: FNT-FY13-01 ELECTRONIC WARFARE BATTLE MANAGEMENT (EWBM) FOR SURFACE DEFENSE<br>- Continue Electronic Warfare Battle Management (EWBM) - Develop components and software used to coordinate Electronic Warfare (EW) Electronic Attack and deception techniques and provide a technology demonstration of Electronic Warfare Battle Management.<br><br>EC: FNT-FY13-03 SILK THREAD<br>- Initiate Product 1- Conduct advanced technology development (details classified).<br>- Initiate Product 2 - Conduct advanced technology development (details classified).<br><br>EC: FNT-FY13-04 DETECTION AND FUSION FOR REMOTE SENSORS<br>- Continue Adaptive Multi-Int Correlation & Identification (AMICA) - Develop, test and modify algorithms to enable cross-domain information fusion and optimize use of remote sensing assets. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Detection & Classification Algorithms (DCA) - Develop, test and modify algorithms to provide enhanced detection and classification metrics and robust performance under stressing environmental conditions.<br><br>EC: FNT-FY14-02 ADAPTIVE TASKING, COLLECTION, PROCESSING, EXPLOITATION AND DISSEMINATION (TCPED) SERVICES<br>- Initiate Adaptive Tasking, Collection, Processing, Exploitation and Dissemination (TCPED) for Anti-Submarine Warfare (ASW) Services - Develop algorithms and software to assure network connectivity for low latency data sharing and autonomous and adaptive Command and Control (C2) services for coordination of data collection and sharing.<br>- Initiate Data Exfiltration and Networked Platform Interaction - Details classified.<br>***FY 2015 Plans:***<br>EC: FNT-FY11-01 PRO-ACTIVE COMPUTER NETWORK DEFENSE AND INFORMATION ASSURANCE<br>- Complete Common Operational Security Decision System - Develop interactive controls for map-based visualization of Computer Network Defense policy deployments.<br>- Complete Next Generation Security and Security Management Protocols - Develop path-aware trusted routing algorithm for maximizing Information Assurance of security management communications.<br>- Complete Next Generation Sensors and Gateways - Develop adaptive learning and decision algorithms for pro-active defense mechanisms and for creating Computer Network Defense policy.<br><br>EC: FNT-FY11-02 FAST MAGIC<br>- Complete Fast Magic Product 1 - Develop real-time algorithms and integrate into Fleet systems.<br>- Complete Fast Magic Product 2 - Develop real-time algorithms and integrate into Fleet systems.<br><br>EC: FNT-FY11-05 NRL SPACE<br>- Complete Multi-INT Tracking - Develop real-time fusion algorithms and visualization techniques to detect, track and visualize current and historical maritime vessel track data.<br>- Complete Tagging - Develop real-time fusion algorithms and visualization techniques to detect, track and visualize current and historical maritime vessel track data.<br><br>EC: FNT-FY12-01 ADVANCED TACTICAL DATA LINK (ATDL)<br>- Continue Mission-Based Waveform Controls & Networking - Integrate completed waveforms into host terminal having NSA certification for field testing demonstration.<br><br>EC: FNT-FY12-02 AUTONOMOUS PERSISTENT TACTICAL SURVEILLANCE | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Autonomous Information-Based Surveillance Control - Integrate and test information based algorithms for UAV routing and patching.<br>- Continue Contextual Enterprise Information - Adapt the analytical services framework and continue development of real-time enterprise exploitation algorithms for transition and participation in Cloud LTE<br>- Continue Mobile Autonomous ISR to C2 Synchronization - Develop enterprise distributed software and begin work on a generalized solution.<br><br>EC: FNT-FY13-01 EW BATTLE MANAGEMENT FOR SURFACE DEFENSE<br>- Continue EW Battle Management (EWBM) - Integrate distributed EW communication and coordination techniques with operational Naval Command and Control and Combat Systems used on surface platforms.<br><br>EC: FNT-FY13-03 SILK THREAD<br>- Continue Product 1 - Conduct Advanced Technology Development.<br>- Continue Product 2 - Conduct Advanced Technology Development.<br><br>EC: FNT-FY13-04 DETECTION AND FUSION FOR REMOTE SENSORS<br>- Continue Adaptive Multi-Int Correlation & Identification (AMICA) - Develop, test and modify algorithms to enable cross-domain information fusion and optimize use of remote sensing assets.<br>- Continue Detection & Classification Algorithms (DCA) - Develop, test and modify algorithms to provide enhanced detection and classification metrics and robust performance under stressing environmental conditions.<br><br>EC: FNT-FY14-02 ADAPTIVE TASKING, COLLECTION, PROCESSING, EXPLOITATION AND DISSEMINATION (TCPED) SERVICES<br>- Continue Adaptive TCPED for ASW Services - Integrate new methods and demonstrate via simulation performance in limited bandwidth environments.<br>- Continue Data Exfiltration and Networked Platform Interaction - Integrate components and evaluate performance in a size, weight and power package consistent with a sonobuoy.<br><br>EC: FNT-FY15-01 ADVANCED AIRBORNE EARLY WARNING ELECTRONIC PROTECTION (AAEWEP)<br>- Initiate Advanced AEW Electronic Protection - Integrate and test E2-D electronic protection techniques.<br><br>EC: FNT-FY15-02 DATA FOCUSED NAVAL TACTICAL CLOUD | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate ASW Naval Tactical Cloud - Develop, integrate and validate, through Limited Technology Experiments , enhanced ASW situational awareness, decision support analytics, and widgets through mission focused exploitation of all relevant cross-domain data within the Naval Tactical Cloud.<br>- Initiate EXW Naval Tactical Cloud - Develop, integrate and demonstrate parts of an expeditionary warfare tactical cloud multi-function mission overwatch system that would be capable of finalizing mission templates and serving as a decision aid during mission execution.<br>- Initiate IAMD Naval Tactical Cloud - Develop and integrate heavy computational analytics and planning algorithms and assess, through Limited Technology Experiments, improved performance through the use of massive parallelism and the rich metadata availability of the Cloud infrastructure.<br><br>EC: FNT-FY15-04 SCALABLE INTEGRATED RF SYSTEM FOR UNDERSEA PLATFORMS (SIRFSUP)<br>- Initiate Compact, Scalable Integrated RF (Compact-SIRF) - Integrate new techniques for data conversion and distribution in low size, weight and power analog RF and digital hardware within compact system design.<br>- Initiate Electronic Warfare Tactical Decision Aid (EW-TACAID) - Integrate an intuitive EW display with an onboard integrated adaptive high fidelity training capability to improve the warfighters' ability to manage increasingly complex RF environments.<br>- Initiate Scalable Integrated RF for Submarines (SIRF-Sub) - Integrate new techniques for data conversion and distribution with RF and digital hardware components for insertion into the next generation submarine EW system. | | | |
| ***Title:*** POWER AND ENERGY (P&E) | 4.333 | 5.574 | 11.084 |
| ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Power and Energy (P&E) FNC pillar. The P&E Pillar develops deliverable technologies that provide new capabilities in energy security, efficient power and energy systems, high energy and pulse power.<br><br>The FY 2013 to FY 2014 increase was due primarily to the initiation of P&E-FY14-01 and the planned ramp-up of P&E-FY12-03.<br><br>The FY 2014 to FY 2015 increase was due primarily to the planned ramp-up of P&E-FY12-03 and P&E-FY14-01, and the initiation of P&E-FY15-03<br><br>***FY 2013 Accomplishments:***<br>EC: P&E-FY12-01 Renewable-Sustainable Expeditionary Power<br>- Continue Renewable Thermal Engine - Conduct lab-based demonstration efforts.<br><br>EC: P&E-FY12-03 Long Endurance Undersea Vehicle Propulsion | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Air Independent Propulsion System - Conduct air-independent energy system, sub-scale component development, analysis, and benchtop testing.<br><br>***FY 2014 Plans:***<br>EC: P&E-FY12-01 RENEWABLE-SUSTAINABLE EXPEDITIONARY POWER<br>- Continue Renewable Thermal Engine - Initiate fabrication and prototype assembly to include signature and susceptibility requirements as well as deployment/stowage mechanisms.<br><br>EC: P&E-FY12-03 LONG ENDURANCE UNDERSEA VEHICLE PROPULSION<br>- Continue Air Independent Propulsion System - Conduct full-scale system component procurement for the Phase II demonstration culminating in a critical design review.<br><br>EC: P&E-FY14-01 EFFICIENT AND POWER DENSE ARCHITECTURE AND COMPONENTS<br>- Initiate High Power Solid State Circuit Protection for Power Distribution and Energy Storage - Design test scenarios suitable for analytical and reduced scale testing of candidate protection methods in a relevant power system environment.<br><br>***FY 2015 Plans:***<br>EC: P&E-FY12-01 RENEWABLE-SUSTAINABLE EXPEDITIONARY POWER<br>- Continue Renewable Thermal Engine - Continue fabrication and prototype assembly to include signature and susceptibility requirements as well as deployment/stowage mechanisms.<br><br>EC: P&E-FY12-03 LONG ENDURANCE UNDERSEA VEHICLE PROPULSION<br>- Continue Air Independent Propulsion System - Integrate system components for packaging and demonstration in a prototype Unmanned Underwater Vehicle energy section hull.<br><br>EC: P&E-FY14-01 EFFICIENT AND POWER DENSE ARCHITECTURE AND COMPONENTS<br>- Continue High Power Solid State Circuit Protection for Power Distribution and Energy Storage - Conduct testing to Phase 1 metrics, select Phase 2 performer, and initiate Phase 2 development, to include reduced scale testing of candidate protection methods in a relevant power system environment.<br><br>EC: P&E-FY15-03 MULTIFUNCTION ENERGY STORAGE FOR NAVY / USMC APPLICATIONS TO MAXIMIZE OPERATIONAL EFFECTIVENESS AND EFFICIENCY<br>- Initiate Compact High Density Tactical Energy Storage - Develop multifunction energy storage module control, interface, thermal management and containment subcomponents for tactical application. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate Multi-Function High Density Shipboard Energy Storage - Develop full scale ship multifunction energy storage module control, interface, thermal management and containment subcomponents for shipboard applications. | | | |
| ***Title:*** SEA BASING (BAS) | 7.222 | 11.666 | 12.223 |
| ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Sea Basing (BAS) FNC pillar. The BAS Pillar develops deliverable logistics, shipping and at-sea transfer technologies that provide new capabilities for projecting expeditionary force from the sea base and providing sea based joint operational independence through improved connector, at-sea transfer and shipboard logistical capabilities.<br><br>The FY 2013 to FY 2014 increase was due primarily to a ramp up of the Environmental Ship Motion Forecasting product within BAS-FY11-01.<br><br>***FY 2013 Accomplishments:***<br>EC: BAS-FY07-02 Surface Connector Vehicle Transfer<br>- Continue Interface Ramp Technologies development, American Bureau of Shipping (ABS) certification, and testing of the JHSV ramp.<br><br>EC: BAS-FY08-03 Sense and Respond Logistics<br>- Complete Common Operating Picture Logistics Decision Support Tool - Integrate and test the information architecture for knowledge management and reasoning capability.<br><br>EC: BAS-FY11-01 Connectors and the Sea Base<br>- Continue Advanced Mooring System - Conduct model testing and planning of at-sea demonstration.<br>- Continue Environmental Ship Motion Forecasting - Develop wave and ship motion forecasting technologies.<br>***FY 2014 Plans:***<br>EC: BAS-FY07-02 Surface Connector Vehicle Transfer<br>- Complete Interface Ramp Technologies development, American Bureau of Shipping (ABS) certification, and testing of the JHSV ramp.<br><br>EC: BAS-FY11-01 CONNECTORS AND THE SEA BASE<br>- Continue Advanced Mooring System - Construct and execute at-sea demonstration.<br>- Continue Environmental Ship Motion Forecasting - Develop wave and ship motion forecasting technologies.<br>***FY 2015 Plans:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: BAS-FY11-01 CONNECTORS AND THE SEA BASE<br>- Complete Advanced Mooring System - Conduct integration, testing, and demonstration of the Advanced Mooring System S&T demonstrator at full-scale in a relevant environment.<br>- Complete Environmental Ship Motion Forecasting - Complete integration and testing of environmental and ship motion sensor and forecasting system. | | | |
| ***Title:*** SEA SHIELD (SHD) | 60.407 | 62.470 | 71.569 |
| ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE that are aligned to the Sea Shield (SHD) FNC pillar. The SHD Pillar develops deliverable technologies that provide new capabilities in theater air and missile defense, anti-submarine warfare, mine countermeasures, defensive surface warfare, global defensive assurance, anti-terrorism, and fleet/force protection.<br><br>The FY 2013 to FY 2014 increase was due primarily to the initiation of SHD-FY14-02, SHD-FY14-04, and SHD-FY14-08, and the planned ramp-up of SHD-FY12-04, SHD-FY13-01 and SHD-FY13-02.<br><br>The FY 2014 to FY 2015 increase was due primarily to the initiation of SHD-FY15-07 and the planned ramp-up of SHD-FY13-07 and SHD-FY-14-02.<br><br>***FY 2013 Accomplishments:***<br>EC: SHD-FY06-03 MCM FOR Maneuver Spiral 2<br>- Complete Tactical UAV Sensor for Detection of Minefields (Buried Mines) in the Beach Zone data collection flight tests and demonstrate system level sensor reliability.<br><br>EC: SHD-FY09-01 Operation of ASW Active Distributed Systems<br>- Complete Mobile System Placement, Source Control, and Pattern Keeping Algorithm - Demonstrate at-sea performance of algorithms implemented in a Tactical Decision Aid to coordinate the search and track capability between mobile low frequency active ASW systems in real time.<br><br>EC: SHD-FY09-06 Countermeasure Technologies for Anti-Ship Missile Defense (ASMD)<br>- Complete Enhanced Nulka Payload - Extended one year to complete development and additional testing of transmitter chip sets.<br>- Complete Enhanced Surface Electronic Warfare Improvement Program (SEWIP) Transmitter - Demonstrate full enhanced SEWIP array performance in a relevant field environment.<br><br>EC: SHD-FY09-08 Four-Torpedo Salvo Defense | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Complete Anti Torpedo Torpedo (ATT) for Surface Ship Defense Against Complex Salvo - Conduct in-water test and evaluation of the anti-torpedo torpedo sensor and controller.<br><br>EC: SHD-FY10-01 Anti-Ship Missile Defense Technologies (Hardkill)<br>- Continue Enhanced Lethality Guidance Algorithms (ELGA) - Develop and test STANDARD Missile guidance algorithms for advanced maneuvering missile threats.<br>- Continue Enhanced Maneuverability Missile Airframe (EMMA) - Develop and test STANDARD Missile motor and control techniques for advanced maneuvering threats.<br><br>EC: SHD-FY10-02 High Fidelity Active Sonar Training<br>- Continue ASW Command Level Training - Develop training capabilities based on algorithms to be used in at-sea and shore training sites that will improve the training realism provided to ASW Commanders and their staffs.<br>- Continue Operator Training - Develop and implements algorithms to provide enhanced training to operators by improving simulated submarine target realism, environmental clutter and reverberation for use in an active sonar training system.<br><br>EC: SHD-FY10-03 Advanced Sonar Technology for High Clearance Rate Mine Countermeasures (MCM)<br>- Continue Integrated Forward looking Sonar - Dual Frequency Synthetic Aperture Sonar (FLS-DFSAS) - Conduct forward looking sonar - dual frequency synthetic aperture sonar algorithm development and conduct experimentation.<br>- Continue Long Range Low Frequency Broad Band (LFBB) Sonar (Autonomous Underwater Vehicle (AUV) Platform Option) - Develop advanced technology for the long range low frequency broadband sonar and perform a field demonstration.<br>- Continue VSW Acoustic Color-Imaging Sonar - Develop and test prototype acoustic projectors, receivers, and processing algorithms.<br><br>EC: SHD-FY10-04 Next Generation Countermeasure Technologies for Ship Missile Defense<br>- Continue Next Generation Countermeasure Technologies for Ship Missile Defense - Develop, fabricate, test and integrate an electronic warfare payload into an unmanned aerial system and command and control link demonstrator.<br><br>EC: SHD-FY10-05 Affordable Vector Sensor Towed Array and Signal Processing<br>- Continue Vector Sensor Towed Array - Develop and build a Vector Sensor Towed Array that provides thin-line twin-line towed array performance in a single thin line towed array for at sea testing.<br>- Continue Vector Sensor Towed Array Signal Processing - Develop and implement algorithms in a system to demonstrate at-sea performance of noise reduction and signal processing algorithms when deployed with a Vector Sensor Towed Array.<br><br>EC: SHD-FY11-01 Torpedo Common Hybrid Fuzing System | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Torpedo Common Hybrid Fuzing System - Conduct field test planning and execution.<br><br>EC: SHD-FY11-02 Integrated Hardkill-Softkill<br>- Complete Integrated Active and Electronic Defense (IAED) - Develop and test optimized response combinations of kinetic and non-kinetic anti-ship missile defenses.<br><br>EC: SHD-FY12-01 Force Level Radar Resource Management for Integrated Air and Missile Defense (IAMD)<br>- Continue Radar Resource Manager for Integrated Air & Missile Defense (IAMD) - Develop and test algorithms for management and coordination of force level AEGIS radar resources.<br><br>EC: SHD-FY12-03 Sonar Automation<br>- Continue Active Sonar Automation - Develop tools, utilizing new algorithms, for use in current active sonar systems that improve operator performance and reduce workload .<br>- Continue Passive Sonar Automation - Develop tools, utilizing new algorithms, for use in current passive sonar systems that improve operator performance and reduce operator workload when used against quiet submarines in the presence of clutter.<br><br>EC: SHD-FY12-04 Detection and Neutralization of Near-Surface Drifting-Oscillating Mines<br>- Continue Compact Modular Sensor-Processing Suite (CMSS) - Integrate sensors into a compact modular configuration and initiation of data collection flight tests.<br><br>EC: SHD-FY13-01 Cooperative Networked Radar<br>- Initiate Cooperative Networked Radar - Develop, implement and test software to enable real-time integration of multiple shipboard radars.<br><br>EC: SHD-FY13-02 Ground Based Air Defense On-the-Move<br>- Initiate GBAD-OTM High Energy Laser Demonstrator - Design, fabricate and demonstrate a radar-cued high energy laser system capable of detecting low radar cross section threats and performing soft and hard kills of unmanned aerial systems while on-the-move.<br><br>EC: SHD-FY13-05 High Altitude ASW (HAASW) from the P-8<br>- Initiate Next Generation Multistatic Active Capability (NGMAC) - Conduct development effort to integrate improved active sources and to provide a state estimation capability in the current multistatic active coherent ASW buoy system. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate Unmanned Targeting Air System (UTAS) - Conduct development effort to integrate a magnetic sensor and algorithms for use on an unmanned aerial vehicle that is sized for deployment from a P-8 aircraft and needed to conduct localization against a submarine.<br><br>EC: SHD-FY13-07 USV Payloads for Single Sortie Mine Countermeasures<br>- Initiate Drifting Mine Neutralization Technology - Develop and modify processing and hardware for neutralization technologies.<br>- Initiate MCM Payload Automation - Develop and modify processing, autonomy, and control technologies for mine warfare environmental decision aid library and mine countermeasure automatic target recognition.<br>- Initiate Single Sortie MCM Detect-to-Engage Payload - Design and develop launch, recovery, communication, recharging systems, and associated algorithms/vehicle payload support hardware.<br><br>***FY 2014 Plans:***<br>EC: SHD-FY09-06 Countermeasure Technologies for Anti-Ship Missile Defense (ASMD)<br>- Complete Enhanced Nulka Payload - Conduct final testing required for transition<br><br>EC: SHD-FY10-01 ANTI-SHIP MISSILE DEFENSE TECHNOLOGIES<br>- Continue Enhanced Lethality Guidance Algorithms (ELGA) - Continue development and testing of STANDARD Missile motor and thrust vector control for advanced maneuvering threats.<br>- Continue Enhanced Maneuverability Missile Airframe (EMMA) - Continue development and testing of STANDARD Missile motor and thrust vector control for advanced maneuvering threats.<br><br>EC: SHD-FY10-02 HIGH FIDELITY ACTIVE SONAR TRAINING<br>- Complete Anti-Submarine Warfare (ASW) Command Level Training - Develop training capabilities based on algorithms to be used at-sea and in shore training sites that will improve the training realism provided to Anti-Submarine Warfare (ASW) Commanders and their Aircraft Carrier support personnel.<br>- Complete Operator Training - Develop and implement algorithms to provide enhanced training to operators by improving simulated submarine target realism, environmental clutter and reverberation for use in an active sonar training system.<br><br>EC: SHD-FY10-03 ADVANCED SONAR TECHNOLOGY FOR HIGH CLEARANCE RATE MINE COUNTERMEASURES (MCM)<br>- Continue Long Range Low Frequency Broadband (LFBB) Sonar (Autonomous Underwater Vehicle (AUV) Platform Option) - Demonstrate at-sea performance of the Long Range Low Frequency Broadband (LFBB) Sonar in a relevant environment.<br>- Continue Integrated Forward looking Sonar - Dual Frequency Synthetic Aperture Sonar (FLS-DFSAS) - Conduct forward looking sonar - dual frequency synthetic aperture sonar algorithm development and conduct experimentation. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Very Shallow Water (VSW) Acoustic Color-Imaging Sonar - Develop and test prototype acoustic projectors, receivers, and processing algorithms.<br><br>EC: SHD-FY10-04 NEXT GENERATION COUNTERMEASURE TECHNOLOGIES FOR SHIP MISSILE DEFENSE<br>- Complete Next Generation Countermeasure Technologies for Ship Missile Defense - Demonstrate compact, net-enabled, open architecture Electronic Attack (EA) systems with threat adaptive processing and response in realistic at-sea environments.<br><br>EC: SHD-FY10-05 AFFORDABLE VECTOR SENSOR TOWED ARRAY AND SIGNAL PROCESSING<br>- Continue Vector Sensor Towed Array - Develop and build a Vector Sensor Towed Array that provides thin-line twin line towed array performance in a single thin-line towed array for at-sea testing.<br>- Continue Vector Sensor Towed Array Signal Processing - Develop and implement algorithms in a system to demonstrate at-sea performance of noise reduction and signal processing algorithms when deployed with a Vector Sensor Towed Array.<br><br>EC: SHD-FY11-01 TORPEDO COMMON HYBRID FUZING SYSTEM<br>- Continue Torpedo Common Hybrid Fuzing System - Conduct system integration and field test planning and execution.<br><br>EC: SHD-FY12-01 FORCE LEVEL RADAR RESOURCE MANAGEMENT FOR INTEGRATED AIR AND MISSILE DEFENSE (IAMD)<br>- Continue Radar Resource Manager for Integrated Air and Missile Defense (IAMD) - Develop and test algorithms for management and coordination of force level AEGIS radar resources.<br><br>EC: SHD-FY12-03 SONAR AUTOMATION<br>- Continue Active Sonar Automation - Develop tools, utilizing new algorithms, for use in current active sonar systems that improve operator performance and reduce workload in high clutter.<br>- Continue Passive Sonar Automation - Develop tools, utilizing new algorithms, for use in current passive sonar systems that improve operator performance and reduce operator workload when used against quiet submarines in the presence of clutter.<br><br>EC: SHD-FY12-04 DETECTION AND NEUTRALIZATION OF NEAR-SURFACE DRIFTING-OSCILLATING MINES<br>- Continue Compact Modular Sensor-Processing Suite (CMSS) - Integrate sensors into a compact modular configuration and initiate data collection flight tests.<br><br>EC: SHD-FY13-01 COOPERATIVE NETWORKED RADAR | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Cooperative Networked Radar - Develop, refine, integrate, and test algorithms to enable real-time integration of multiple shipboard radars.<br><br>EC: SHD-FY13-02 GROUND BASED AIR DEFENSE ON-THE-MOVE (GBAD-OTM)<br>- Complete Ground Based Air Defense On-the Move (GBAD-OTM) High Energy Laser Demonstrator - Design, fabricate and demonstrate a radar-cued high energy laser system capable of detecting low radar cross section threats and performing soft and hard kills of unmanned aerial systems while on-the-move.<br><br>EC: SHD-FY13-05 HIGH ALTITUDE ANTI SUBMARINE WARFARE (HAASW) FROM THE P-8<br>- Continue Next Generation Multistatic Active Capability (NGMAC) - Conduct development effort to integrate improved active sources and to provide a state estimation capability in the current multi-static active coherent Anti-Submarine Warfare (ASW) sonobuoy system.<br>- Continue Unmanned Targeting Air System (UTAS) - Conduct development effort to integrate a magnetic sensor and algorithms for use on an unmanned aerial vehicle that is sized for deployment from a P-8 aircraft and needed to target a submarine.<br><br>EC: SHD-FY13-07 UNMANNED SURFACE VEHICLE (USV) PAYLOADS FOR SINGLE SORTIE MINE COUNTERMEASURES<br>- Continue Drifting Mine Neutralization Technology - Develop and modify processing and hardware for neutralization technologies<br>- Continue Mine Countermeasures (MCM) Payload Automation - Develop and modify processing, autonomy, and control technologies for mine warfare environmental decision aid library and mine countermeasure automatic target recognition.<br>- Continue Single Sortie Mine Countermeasures (MCM) Detect-to-Engage Payload - Design and develop launch, recovery, communication, recharging systems, and associated algorithms/vehicle payload support hardware.<br><br>EC: SHD-FY14-02 FULL SECTOR TORPEDO DEFENSE<br>- Initiate ATT Timeline Compression (ATTTC) - Begin in-water sub-component testing and data collection.<br>- Initiate Concept C Countermeasure - Refine transducer design and integration.<br><br>EC: SHD-FY14-04 ADVANCED UNDERSEA WEAPON SYSTEM (AUWS)<br>- Initiate Autonomous Threat Detection and Localization - Develop low-power compact sensor nodes and integrate them to the node deployment module.<br>- Initiate Remote Command & Control - Develop communications packages and integrate them to the sensor, weapon and gateway nodes.<br>- Initiate Tactical Positioning & Fire Control - Develop sensor, weapon and gateway node deployment modules, and integrate them to a Large Diameter Unmanned Undersea Vehicle (UUV) test-bed. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: SHD-FY14-08 TIER 3 HIGH VALUE UNIT (HVU) SELF-DEFENSE<br>- Initiate Adaptive Hypothesis-based Fire Control - Develop and test fire control solutions using modern electronic support data.<br>- Initiate Advanced ESSM Guidance - Develop and test guidance algorithms to increase lethality over the maximum outer self-defense kinematic envelope.<br>- Initiate Advanced Rolling Airframe Missile (RAM) Block 2 Guidance - Develop and test guidance algorithms to increase lethality over the maximum inner self-defense kinematic envelope. | | | |
| ***FY 2015 Plans:***<br>EC: SHD-FY10-01 ANTI-SHIP MISSILE DEFENSE TECHNOLOGIES<br>- Continue Enhanced Lethality Guidance Algorithms (ELGA) - Conduct hardware-in-the-loop testing of the ELGA guidance algorithm.<br>- Continue Enhanced Maneuverability Missile Airframe (EMMA) - Conduct risk reduction rocket motor testing to demonstrate performance against exit criteria.<br><br>EC: SHD-FY10-03 ADVANCED SONAR TECHNOLOGY FOR HIGH CLEARANCE RATE MCM<br>- Complete Integrated Forward looking Sonar - Dual Frequency Synthetic Aperture Sonar (FLS-DFSAS) - Conduct forward looking sonar dual frequency synthetic aperture sonar algorithm development and conduct at-sea experimentation and demonstration.<br>- Continue Long Range LFBB Sonar (AUV Platform Option) - Demonstrate at-sea performance of the Long Range LFBB sonar in a relevant environment.<br>- Complete Very Shallow Water (VSW) Acoustic Color-Imaging Sonar - Conduct final testing required for transition.<br><br>EC: SHD-FY10-05 AFFORDABLE VECTOR SENSOR TOWED ARRAY AND SIGNAL PROCESSING<br>- Complete Vector Sensor Towed Array - Develop and deliver a thin-line Vector Sensor Towed Array (VSTA) system and demonstrate thin-line twin-line capability in a single array.<br>- Complete Vector Sensor Towed Array Signal Processing - Deliver sonar signal processing hardware and software for experimentation and transition into the Advanced Processor Build for FY-17.<br><br>EC: SHD-FY11-01 TORPEDO COMMON HYBRID FUZING SYSTEM<br>- Complete Torpedo Common Hybrid Fuzing System - Conduct system integration, field testing and demonstration of a prototype system, and transition the system to acquisition for engineering development.<br><br>EC: SHD-FY12-01 FORCE LEVEL RADAR RESOURCE MANAGEMENT FOR INTEGRATED AIR AND MISSILE DEFENSE (IAMD)<br>- Continue Radar Resource Manager for IAMD - Conduct end-to-end testing to validate algorithms. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: SHD-FY12-03 SONAR AUTOMATION<br>- Continue Active Sonar Automation - Develop tools, utilizing new algorithms, for use in current active sonar systems that improve operator performance and reduce workload.<br>- Continue Passive Sonar Automation - Develop tools utilizing new algorithms for use in current passive sonar systems that improve operator performance and reduce operator workload when used against quiet submarines in the presence of clutter.<br><br>EC: SHD-FY12-04 DETECTION AND NEUTRALIZATION OF NEAR-SURFACE DRIFTING-OSCILLATING MINES<br>- Continue Compact Modular Sensor-Processing Suite (CMSS) - Integrate LIDAR into compact configuration and initiate data collection flight tests.<br><br>EC: SHD-FY13-01 COOPERATIVE NETWORKED RADAR<br>- Continue Cooperative Networked Radar - Integrate and test cross platform radar operation.<br><br>EC: SHD-FY13-05 HIGH ALTITUDE ASW (HAASW) FROM THE P-8<br>- Continue Next Generation Multistatic Active Capability (NGMAC) - Improve and evaluate the performance of hardware and software for use in improving the Multistatic Active Capability sonobuoys and P-8A signal processing.<br>- Continue Unmanned Targeting Air System (UTAS) - Integrate Compact magnetometers into the Unmanned Air System (UAS) candidates and develop test plans for a maneuver table to compare Tier 1 and Tier 2 UAS's for the ASW mission.<br><br>EC: SHD-FY13-07 USV PAYLOADS FOR SINGLE SORTIE MINE COUNTERMEASURES<br>- Continue USV-based Mine Neutralization (formerly called Drifting Mine Neutralization Technology) - Develop and modify processing and hardware for neutralization technologies.<br>- Continue MCM Payload Automation - Integrate and modify processing, autonomy, and control technologies for mine warfare environmental decision aid library and mine countermeasures automatic target recognition.<br>- Continue Single Sortie MCM Detect-to-Engage Payload - Design and develop launch, recovery, communication, recharging systems, and associated algorithms/vehicle payload support hardware.<br><br>EC: SHD-FY14-02 FULL SECTOR TORPEDO DEFENSE<br>- Continue ATT Timeline Compression (ATTTC) - Conduct real-time coding of bistatic detection and automatic preset/launch sequence.<br>- Complete Concept C Countermeasure - Conduct hardware fabrication.<br>- Initiate HVU Mounted Sonar - Begin component prototype development of transducer array and electronics. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: SHD-FY14-04 ADVANCED UNDERSEA WEAPON SYSTEM (AUWS)<br>- Continue Autonomous Threat Detection and Localization - Build initial AUWS sensor nodes and integrate them into the Build initial AUWS sensor nodes.<br>- Continue Remote Command & Control - Build and integrate the AUWS communications packages into the AUWS nodes, and conduct functional testing.<br>- Continue Tactical Positioning & Fire Control - Build the AUWS node deployment modules, integrate into a UUV test-bed, and conduct functional testing.<br><br>EC: SHD-FY14-08 TERMINATOR (T3)<br>- Continue Adaptive Hypothesis-based Fire Control - Conduct modeling and simulation testing of the algorithm in a realistic environment.<br>- Continue Advanced ESSM Guidance - Conduct modeling and simulation testing of the algorithm in a realistic environment.<br>- Continue Advanced RAM Block 2 Guidance - Conduct modeling and simulation testing of the algorithm in a realistic environment.<br><br>EC: SHD-FY15-07 HYPER VELOCITY PROJECTILE<br>- Initiate Hyper Velocity Projectile - Design, fabricate and begin assembly of hypervelocity projectiles in preparation for full-up launch to validate common interfaces for powder gun and railgun launch. | | | |
| ***Title:*** SEA STRIKE (STK) | 32.464 | 36.560 | 46.714 |
| ***Description:*** This R-2 Activity contains all Future Naval Capabilities (FNC) Program Enabling Capability (ECs) investments in this PE. The Sea Strike (STK) FNC pillar develops deliverable technologies that provide new capabilities in power projection and deterrence, precise and persistent offensive power, weapons, aircraft, and expeditionary warfare.<br><br>The FY 2013 to FY 2014 increase was due primarily to the initiation of STK-FY14-01 and STK-FY14-03.<br><br>The FY 2014 to FY 2015 increase was due primarily to the planned ramp-up of STK-FY13-01, STK-FY13-02, STK-FY13-03, STK-FY13-04, STK-FY14-01 and STK-FY14-03, and the initiation of STK-FY15-01, STK-FY15-02 and STK-FY15-03.<br><br>***FY 2013 Accomplishments:***<br>EC: STK-FY08-04 Next Generation Airborne Electronic Attack<br>- Complete Next Generation Airborne Electronic Attack - Conduct a detailed evaluation of advanced component technologies that are capable of integration into the Next Generation Jammer program. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| EC: STK-FY08-06 Increased Capability Against Moving and Stationary Targets.<br>- Complete Direct Attack Seeker Head - Develop and test the sensor subsystem packaged within a BRITE Star II turret.<br>- Complete Multi-Mode Sensor Seeker - Develop and demonstrate the Multi-Mode Sensor/Seeker (MMSS) on the BRITE Star II.<br><br>EC: STK-FY09-03 Enhanced Weapons Technologies<br>- Continue Counter Air Defense Improvements - Demonstrate propulsion system, manufacture hardware, cast propellant grains, assemble rocket motors and test in both performance and insensitive munitions conditions.<br>- Complete High Speed Components - Demonstrate an advanced radome, fabrication of full scale radome and performance testing under relevant environmental conditions.<br>- Complete Counter Air Advanced Medium-Range Air-to-Air Missile (AMRAAM) Improvements - Demonstrate propulsion system, manufacture hardware, cast propellant grains, assemble rocket motors and test in both environmental and static conditions.<br><br>EC: STK-FY09-05 Advanced Threat Aircraft Countermeasures<br>- Complete Countermeasures for Advanced I2R - Conduct flight testing of the developed Counter-Imaging Infrared (I2R) techniques.<br>- Complete Countermeasures for millimeter wave - Conduct detailed flight testing of the Ka- and W-band decoys.<br><br>EC: STK-FY09-07 Helicopter Low-Level Operations (HELO)<br>- Complete Distributed Millimeter Wave Sensor - Conduct final testing and demonstration of the millimeter wave sensor in a degraded environment.<br>- Complete Laser Based Helicopter Landing Aids - Conduct final testing and demonstration of the LIDAR imaging capability in a degraded environment.<br><br>EC: STK-FY10-02 Multi-Target Track and Terminate (MTTT)<br>- Continue Multi-Target Laser Designation (MTLD) - Develop advanced optical techniques to include algorithm, laser, and fast steering mirror development.<br><br>EC: STK-FY11-01 Strike Accelerator<br>- Continue Strike Accelerator - Demonstrate new technologies that enable utilizing tactical aircraft Radar and forward looking infrared sensors to quickly identify and target maritime threats.<br><br>EC: STK-FY11-02 Radar Electronic Attack Protection (REAP) | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Identification and Defeat of EA Systems (IDEAS) - Prototype and test advanced algorithms to counter adversary jammers.<br>- Continue Network "Sentric" Electronic Protection (EP) - Develop, implement and test an advanced electronic protection solution.<br><br>EC: STK-FY12-01 Submarine Survivability - Electronic Warfare<br>- Continue Coherent Electronic Attack for Submarines (CEAS) - Develop, fabricate and test electronic warfare payload hardware and software for the submarine mast.<br><br>EC: STK-FY12-02 High Energy Spectrally Beam Combined (SBC) Fiber Laser System<br>- Continue High Energy Fiber Laser System - Demonstrate a high energy laser weapon system suitable for an airborne platform.<br><br>EC: STK-FY13-02 Hostile Fire (HF) Suppression<br>- Initiate Hostile Fire Suppression System - Develop, integrate and test advanced closed-loop tracking techniques with eye-safe laser technology to effectively dazzle hostile shooters to rotary-wing aircraft.<br><br>EC: STK-FY13-04 AIM-9X Enablers (AXE)<br>- Continue SMOKE - Develop an advanced kinematic improvement to the AIM-9X Sidewinder missile.<br>***FY 2014 Plans:***<br>EC: STK-FY09-03 ENHANCED WEAPONS TECHNOLOGIES<br>- Continue Counter Air Defense Improvements - Finish propulsion system, manufacture hardware, cast propellant grains, assemble rocket motors and test in both performance and insensitive munitions conditions.<br>- Complete High Speed Components - Finish development and conduct final testing required for transition.<br><br>EC: STK-FY10-02 MULTI-TARGET TRACK AND TERMINATE (MTTT)<br>- Complete Multi-Target Laser Designation (MTLD) - Develop and integrate field-test and acceptance-test individual system components.<br><br>EC: STK-FY11-01 STRIKE ACCELERATOR<br>- Continue Strike Accelerator - Demonstrate new technologies that enable utilizing tactical aircraft Radar and forward looking infrared sensors to quickly identify and target maritime threats.<br><br>EC: STK-FY11-02 RADAR ELECTRONIC ATTACK PROTECTION (REAP) | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue Identification and Defeat of EA Systems (IDEAS) - Develop system components and/or software for Electronic Support and Electronic Protection techniques and provide a technology demonstration of these components.<br>- Continue Network "Sentric" Electronic Protection (EP) - Develop, implement, test and demonstrate an electronic protection solution.<br><br>EC: STK-FY12-01 SUBMARINE SURVIVABILITY - ELECTRONIC WARFARE.<br>- Continue Coherent Electronic Attack for Submarines (CEAS) - Perform threat assessment analysis, effects modeling, radar system baselining, detection/classification techniques and builder improvements.<br><br>EC: STK-FY12-02 HIGH ENERGY SBC FIBER LASER SYSTEM<br>- Complete High Energy Fiber Laser System - Demonstrate a high energy laser weapon system suitable for an airborne platform.<br><br>EC: STK-FY13-01 LONG RANGE RF FIND, FIX AND ID<br>- Initiate Long Range Find, Fix and ID - Develop, implement, and test software to implement long range RF localization and identification from airborne radars.<br><br>EC: STK-FY13-02 HOSTILE FIRE (HF) SUPPRESSION<br>- Continue Hostile Fire Suppression System - Develop highly efficient low weight multi-band laser source.<br><br>EC: STK-FY13-03 ANTI-SURFACE WARFARE (ASUW) WEAPON UPGRADE<br>- Initiate Anti-Surface Warfare (ASuW) Weapon Upgrade - Begin initial laboratory testing and evaluation.<br><br>EC: STK-FY13-04 AIM-9X ENABLERS (AXE)<br>- Continue SMOKE - Develop an advanced kinematic improvement to the AIM-9X Sidewinder missile.<br><br>EC: STK-FY14-01 PASSIVE SENSOR SURVEILLANCE (PASS)<br>- Initiate PAssive Sensor Surveillance (PASS) - Develop software architecture and associated algorithms that provide for fusion of exploration of sensor data.<br><br>EC: STK-FY14-03 INTELLIGENT COLLABORATIVE ENGAGEMENT (ICE)<br>- Initiate Collaborative Anti-Surface Warfare Engagement (CASE) - Initiate the demonstration of feasibility and an assessment of software operability and inter-operability for flexible weapon behaviors at the salvo level in an Anti-Access / Area Denial environment. | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Initiate Collaborative Electronic Attack (CEA) - Perform Trade Studies and Analysis on Command and Control (C2) Data Types and Networking Requirements.<br><br>***FY 2015 Plans:***<br>EC: STK-FY09-03 ENHANCED WEAPONS TECHNOLOGIES<br>- Complete Counter Air Defense Improvements - Finish propulsion system, manufacture hardware, cast propellant grains, assemble rocket motors and test in both performance and insensitive munitions conditions.<br><br>EC: STK-FY11-01 STRIKE ACCELERATOR<br>- Complete Strike Accelerator - Transition new technologies that enable utilizing tactical aircraft Radar and forward looking infrared sensors to quickly identify and target maritime threats at extended range.<br><br>EC: STK-FY11-02 RADAR ELECTRONIC ATTACK PROTECTION (REAP)<br>- Complete Identification and Defeat of EA Systems (IDEAS) - Integrate and test highly robust EW techniques that protect U.S. forces from Advanced Electronic Attack Systems.<br>- Complete Network "Sentric" Electronic Protection (EP) - Integrate and test techniques for APG-79 electronic protection.<br><br>EC: STK-FY12-01 SUBMARINE SURVIVABILITY - ELECTRONIC WARFARE<br>- Continue Coherent Electronic Attack for Submarines (CEAS) - Integrate robust and highly advanced electronic attack techniques to provide a collaborative electronic attack capability against surface targets.<br><br>EC: STK-FY13-01 LONG RANGE RF FIND, FIX AND ID<br>- Continue Long Range Find, Fix and ID - Integrate and test algorithms for moving maritime RF identification.<br><br>EC: STK-FY13-02 HOSTILE FIRE (HF) SUPPRESSION<br>- Continue Hostile Fire Suppression System - Continue visible dazzle effectiveness requirements experiments.<br><br>EC: STK-FY13-03 ANTI-SURFACE WARFARE (ASUW) WEAPON UPGRADE<br>- Continue Anti-Surface Warfare (ASuW) Weapon Upgrade - Conduct Phase I demonstration.<br><br>EC: STK-FY13-04 AIM-9X ENABLERS (AXE)<br>- Continue SMOKE - Develop an advanced kinematic improvement to the AIM-9X Sidewinder missile.<br><br>EC: STK-FY14-01 PASSIVE SENSOR SURVEILLANCE (PASS) | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continue PAssive Sensor Surveillance (PASS) - Develop the software architecture and associated algorithms that provide for fusion of passive sensor data.<br><br>EC: STK-FY14-03 INTELLIGENT COLLABORATIVE ENGAGEMENT (ICE)<br>- Continue Collaborative Anti-Surface Warfare Engagement (CASE) - Demonstrate software operability and inter-operability for flexible weapon behaviors at the salvo level in an Anti-Access, Area Denial environment.<br>- Continue Collaborative Electronic Attack (CEA) - Integrate robust and highly advanced electronic attack techniques to provide a collaborative electronic attack capability against surface targets.<br><br>EC: STK-FY15-01 SYNTHETIC APERTURE RADAR ELECTRONIC PROTECTION (SAREP)<br>- Initiate Synthetic Aperture Radar Electronic Protection - Integrate and test synthetic aperture radar electronic protection algorithms and techniques.<br><br>EC: STK-FY15-02 ROTOR-CRAFT ADVANCED PROTECTION FROM IR/EO/RPG (RAPIER)<br>- Initiate Helicopter Active RPG Protection (HARP) - Demonstrate the technological feasibility of a Rocket Propelled Grenade (RPG) hard-kill defense system and its component operability on the MV-22.<br>- Initiate Multi-Spectral EO/IR Seeker Defeat - Integrate existing and developmental EO/IR diode sources into the existing Counter Measure Jammer free space and fiber based optical designs.<br><br>EC: STK-FY15-03 EXTENDED RANGE MODULAR UNDERSEA HEAVYWEIGHT VEHICLE (ER MUHV)<br>- Initiate MUHV Autonomy Suite - Initiate open-loop testing of the autonomy suite.<br>- Initiate MUHV Sensors, Navigation and Guidance - Initiate communication system open-loop testing. | | | |
| **Accomplishments/Planned Programs Subtotals** | 225.653 | 247.836 | 256.144 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>3346 / *Future Naval Capabilities Adv Tech Dev* |

**E. Performance Metrics**

As discussed in Section A, there are a significant number of FNC technology products within this PE. In all cases, these technology products support the Department of the Navy's FNC Program and are managed at the Office of Naval Research. All FNC investments in this PE are subjected to management oversight by 2-star chaired Integrated Product Teams (IPTs) that control the naval pillars of Sea Shield, Sea Strike, Sea Basing, Forcenet, Naval Expeditionary Maneuver Warfare, Enterprise and Platform Enablers, Power and Energy, Capable Manpower, and Force Health Protection. Each EC is aligned to a pillar and each technology product is aligned to an EC. At the lowest level, each technology product is measured against both technical and financial milestones on a monthly basis. Annually, each technology product is reviewed in depth for technical performance and development status by the Chief of Naval Research against goals that have been approved by the Navy's 3-star Technology Oversight Group (TOG). Also annually, each technology product is reviewed by its 2-star chaired pillar IPT for transition planning and adequacy and transition commitment level. Products must meet TOG required transition commitment levels for S&T development to continue. Transition issues and required adjustments are reported annually by the Chief of Naval Research to the TOG, which establishes investment priorities for the FNC Program.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | R-1 Program Element (Number/Name)<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | Project (Number/Name)<br>9999 / *Congressional Adds* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9999: *Congressional Adds* | - | 29.334 | 5.000 | - | - | - | - | - | - | - | - | 34.334 |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

The efforts described in this Project address the Advanced Technology Development associated with the Future Naval Capabilities (FNC) Program. The FNC Program represents the requirements-driven, delivery-oriented portion of the Navy's Science and Technology (S&T) portfolio. FNC investments respond to Naval S&T Gaps that are identified by the Navy and Marine Corps after receiving input from Naval Research Enterprise (NRE) stakeholders. The Enabling Capabilities (ECs) and associated technology product investments of the FNC Program are competitively selected by a 3-star Technology Oversight Group (TOG), chartered by the S&T Corporate Board and representing the requirements, acquisition, research and fleet/forces communities of the Navy and the Marine Corps.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 |
|---|---|---|
| ***Congressional Add:*** ASW Research Prog - Cong<br>***FY 2013 Accomplishments:*** N/A<br>***FY 2014 Plans:*** N/A | - | 5.000 |
| ***Congressional Add:*** Technology Transition<br>***FY 2013 Accomplishments:*** The purpose of the funding is to restore unjustified FY13 reductions to multiple FNC Products already in development with in-place government activities and contract performers. The funds will thus be able to be obligated and expended very quickly, restoring shortfalls at these government activities and with the contract performers. A funding plan has been developed that will enable the Office of Naval Research to meet its delivery commitments as previously negotiated with acquisition programs of record via signed Technology Transition Agreements.<br>***FY 2014 Plans:*** N/A | 29.334 | - |
| **Congressional Adds Subtotals** | 29.334 | 5.000 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603673N / *(U)Future Naval Capabilities Advanced Tech Dev* | **Project (Number/Name)**<br>9999 / *Congressional Adds* |

**E. Performance Metrics**

In all cases, FNC technology products support the Department of the Navy's FNC Program and are managed at the Office of Naval Research. All FNC investments in this PE are subjected to management oversight by 2-star chaired Integrated Product Teams (IPTs). Each EC is aligned to a pillar and each technology product is aligned to an EC. At the lowest level, each technology product is measured against both technical and financial milestones on a monthly basis. Annually, each technology product is reviewed in depth for technical performance and development status by the Chief of Naval Research against goals that have been approved by the Navy's 3-star Technology Oversight Group (TOG). Also annually, each technology product is reviewed by its 2-star chaired pillar IPT for transition planning and adequacy and transition commitment level. Products must meet TOG required transition commitment levels for S&T development to continue. Transition issues and required adjustments are reported annually by the Chief of Naval Research to the TOG, which establishes investment priorities for the FNC Program.

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | | Date: March 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | | | | | R-1 Program Element (Number/Name)<br>PE 0603729N *I Warfighter Protection Adv Tech* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 39.085 | 40.460 | 4.838 | - | 4.838 | 4.812 | 4.894 | 4.982 | 4.982 | Continuing | Continuing |
| 2914: *Warfighter Protection Adv Tech* | 0.000 | 3.610 | 4.760 | 4.838 | - | 4.838 | 4.812 | 4.894 | 4.982 | 4.982 | Continuing | Continuing |
| 9999: *Congressional Adds* | 0.000 | 35.475 | 35.700 | - | - | - | - | - | - | - | - | 71.175 |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

FY 2013 funding associated with Future Naval Capability (FNC) efforts are transferring to a new Program Element titled Future Naval Capabilities Advanced Technology Development (PE 0603673N). This is to enhance the visibility of the FNC Program by providing an easily navigable overview of all 6.3 FNC investments in a single location.

**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 (Sep 2011). 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 and technologies to improve warfighter safety and to enhance personnel performance under adverse conditions. Navy investment in these areas is essential because Navy/USMC mission needs are not adequately addressed by the civilian sector or other Federal agencies. These projects support funds future capabilities within the Force Health Protection Program, a Future Naval Capability (FNC) that will provide technology options for the future Navy and Marine Corps by reducing morbidity and mortality when casualties occur.

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, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | **R-1 Program Element (Number/Name)**<br>PE 0603729N *I Warfighter Protection Adv Tech* |

| B. Program Change Summary ($ in Millions) | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 3.880 | 4.760 | 4.838 | - | 4.838 |
| Current President's Budget | 39.085 | 40.460 | 4.838 | - | 4.838 |
| Total Adjustments | 35.205 | 35.700 | - | - | - |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | 35.700 | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | -0.014 | - | | | |
| • SBIR/STTR Transfer | -0.251 | - | | | |
| • Rate/Misc Adjustments | - | - | - | - | - |
| • Congressional General Reductions Adjustments | -3.230 | - | - | - | - |
| • Congressional Add Adjustments | 38.700 | - | - | - | - |

| Congressional Add Details ($ in Millions, and Includes General Reductions) | FY 2013 | FY 2014 |
|---|---|---|
| **Project:** 9999: *Congressional Adds* | | |
| Congressional Add: *CW Bill Young Marrow Donor Program* | 28.888 | 31.500 |
| Congressional Add: *Naval Special Warfare Performance and Injury Prevention Program* | 6.587 | 4.200 |
| Congressional Add Subtotals for Project: 9999 | 35.475 | 35.700 |
| Congressional Add Totals for all Projects | 35.475 | 35.700 |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | | | | | R-1 Program Element (Number/Name)<br>PE 0603729N / *Warfighter Protection Adv Tech* | | | | Project (Number/Name)<br>2914 / *Warfighter Protection Adv Tech* | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| 2914: *Warfighter Protection Adv Tech* | - | 3.610 | 4.760 | 4.838 | - | 4.838 | 4.812 | 4.894 | 4.982 | 4.982 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** NAVAL NOISE-INDUCED HEARING LOSS (NIHL) | 3.610 | 4.760 | 4.838 |
| ***Description:*** 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. | | | |
| ***FY 2013 Accomplishments:***<br>Noise Induced Hearing Loss:<br>- Continued advanced research in medical prevention and treatment of NIHL and tinnitus (ringing in the ears).<br>- Continued advanced research to reduce noise at the source, jet engine quieting and flight deck noise reduction.<br>- Continued advanced research to improve personal protective equipment technology.<br>- Continued advanced research to study the incidence and susceptibility of NIHL and tinnitus, and to evaluate mitigation strategies.<br>- Completed research to reduce noise at the source, i.e., shipboard and flight deck noise reduction.<br><br>Regenerative Medicine:<br>- Initiated program with Army, in regenerative medicine (Armed Forces Institute for Regenerative Medicine (AFIRM I). | | | |
| ***FY 2014 Plans:*** | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603729N / *Warfighter Protection Adv Tech* | **Project (Number/Name)**<br>2914 / *Warfighter Protection Adv Tech* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Noise Induced Hearing Loss:<br>- Continue all efforts of FY 2013, less those noted as completed above.<br><br>Regenerative Medicine:<br>- Complete program with Army, in regenerative medicine (Armed Forces Institute for Regenerative Medicine (AFIRM I).<br>- Initiate program with Army, in regenerative medicine (Armed Forces Institute for Regenerative Medicine (AFIRM II).<br>***FY 2015 Plans:***<br>Noise Induced Hearing Loss:<br>- Continue all efforts of FY 2014.<br><br>Regenerative Medicine:<br>- Continue all efforts of FY 2014, less those noted as completed above. | | | |
| **Accomplishments/Planned Programs Subtotals** | 3.610 | 4.760 | 4.838 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**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-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | R-1 Program Element (Number/Name)<br>PE 0603729N / *Warfighter Protection Adv Tech* | Project (Number/Name)<br>9999 / *Congressional Adds* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9999: *Congressional Adds* | - | 35.475 | 35.700 | - | - | - | - | - | - | - | - | 71.175 |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

Congressional Interest Items not included in other Projects.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 |
|---|---|---|
| ***Congressional Add:*** CW Bill Young Marrow Donor Program | 28.888 | 31.500 |

***FY 2013 Accomplishments:*** NMDP:
NMDP continued to expand participation of transplant centers in RITN. Hospitals that participate in both the NMDP Network of treatment centers as well as the NDMS that is managed by the Department of Health and Human Services were invited to join RITN. As a result of this targeted recruitment, eight additional transplant centers joined; unfortunately two centers were lost to attrition resulting in a total composition of: 47 transplant centers, 6 donor centers, and 7 cord blood banks.

A new initiative that began was the Site Assessment program that involved an NMDP staff member reviewing existing documentation at 11 RITN transplant centers against a standardized checklist. As a result, many best practices were gleaned from these centers and the RITN SOP template was updated based on the content of the checklists.

NMRC:
During this period, the C. W. Bill Young Marrow Donor Recruitment and Research Program, BMRD, NMRC directly contributed to donor recruitment and transplantation and science and technology developments. This includes over 5,000 transplants coordinated by the NMDP of which over 500 were provided by DoD volunteers through the NMRC / Georgetown part of the program. The NMDP added over 700,000 volunteer donors to the national registry, of which over 40,000 were from DoD volunteers from the NMRC / Georgetown. Numerous science and technology accomplishments are included and these developments are translated into the development of medical countermeasures to respond to potential marrow toxic injury which are linked to the national effort to develop medical countermeasures for radiation injury.

Georgetown:
Donor Center Progress

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603729N / *Warfighter Protection Adv Tech* | **Project (Number/Name)**<br>9999 / *Congressional Adds* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 |
|---|---|---|
| The DoD registry includes 707,913 volunteers of which 45,362 volunteers were recruited in 2011. There were 8,709 health evaluations and confirmatory HLA typings requested in 2011 and 892 requests were made for stem cell collection of which 577 went to actual collection.<br><br>Probe Testing Progress:<br>The laboratory tested 17,885 new volunteers for HLA-A,-B; 17,885 for HLA-C, and 20,805 for HLA-DRB1. In the first three months the laboratory has typed 18,615 donors for HLA-DQB1 and is currently working on providing HLADPB1 typing for those donors. They are currently working on establishing and validating robust assays for DQB1 and DPB1 because of recent studies suggesting that these loci may impact outcome of transplantation; DQB1 when a mismatched donor is selected and DPB1 when a donor with a T cell epitope mismatch is selected.<br><br>Sequencing Progress Report:<br>Through this grant they continue to improve the robotics and reagents to test samples flow by typing large numbers of donors at recruitment. The PI and team are currently typing 1000 volunteers of European ancestry for the registry using a one step SBT typing method. They previously sequenced 196 loci from patients and potentially matched family members.<br><br>***FY 2014 Plans:*** N/A | | |
| ***Congressional Add:*** Naval Special Warfare Performance and Injury Prevention Program<br><br>***FY 2013 Accomplishments:*** This effort continued the data collection at Naval Special Warfare Group 2 (Little Creek) and Naval Special Warfare Group 4, Special Boat Team 22 (Stennis), Seal Qualification Training (Coronado) to strategically maximize human capital by reducing the rate of unintentional musculoskeletal injury, sharpen battlefield performance, optimize military readiness, extend the lifecycle of the Operator, and enhance quality of life of the Operator after service.<br><br>***FY 2014 Plans:*** N/A | 6.587 | 4.200 |
| **Congressional Adds Subtotals** | 35.475 | 35.700 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603729N / *Warfighter Protection Adv Tech* | **Project (Number/Name)**<br>9999 / *Congressional Adds* |

**E. Performance Metrics**

Congressional Interest Items not included in other Projects.

THIS PAGE INTENTIONALLY LEFT BLANK

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | | Date: March 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | | | | | R-1 Program Element (Number/Name)<br>PE 0603747N *I Undersea Warfare Advanced Tech* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 9.164 | - | 9.985 | - | 9.985 | 14.983 | 19.982 | - | - | - | 54.114 |
| 2916: *Undersea Warfare Advanced Technology* | 0.000 | - | - | 9.985 | - | 9.985 | 14.983 | 19.982 | - | - | - | 44.950 |
| 9999: *Congressional Adds* | 0.000 | 9.164 | - | - | - | - | - | - | - | - | - | 9.164 |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

FY 2013 funding associated with Future Naval Capability (FNC) efforts are transferring to a new Program Element titled Future Naval Capabilities Advanced Technology Development (PE 0603673N). This is to enhance the visibility of the FNC Program by providing an easily navigable overview of all 6.3 FNC investments in a single location.

**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 (Sep 2011). 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, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | **R-1 Program Element (Number/Name)**<br>PE 0603747N *I Undersea Warfare Advanced Tech* |

| B. Program Change Summary ($ in Millions) | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | - | - | - | - | - |
| Current President's Budget | 9.164 | - | 9.985 | - | 9.985 |
| Total Adjustments | 9.164 | - | 9.985 | - | 9.985 |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | - | - | | | |
| • SBIR/STTR Transfer | - | - | | | |
| • Program Adjustments | - | - | 10.000 | - | 10.000 |
| • Rate/Misc Adjustments | - | - | -0.015 | - | -0.015 |
| • Congressional General Reductions Adjustments | -0.836 | - | - | - | - |
| • Congressional Add Adjustments | 10.000 | - | - | - | - |

| Congressional Add Details ($ in Millions, and Includes General Reductions) | FY 2013 | FY 2014 |
|---|---|---|
| **Project:** 9999: *Congressional Adds* | | |
| Congressional Add: *ASW Research Prog - Cong* | 9.164 | - |
| Congressional Add Subtotals for Project: 9999 | 9.164 | - |
| Congressional Add Totals for all Projects | 9.164 | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | R-1 Program Element (Number/Name)<br>PE 0603747N / *Undersea Warfare Advanced Tech* | Project (Number/Name)<br>2916 / *Undersea Warfare Advanced Technology* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2916: *Undersea Warfare Advanced Technology* | - | - | - | 9.985 | - | 9.985 | 14.983 | 19.982 | - | - | - | 44.950 |

# The FY 2015 OCO Request will be submitted at a later date.

**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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** Naval Forces UUV Development | - | - | 9.985 |
| ***Description:*** Develop critical technology for Long Endurance LDUUV to meet 30+ days. Critical technology includes Energy, Autonomy, and Endurance. INP - Large Displacement UUV (LD UUV)<br><br>FY 2014 to FY 2015 funding increase is due to the initiation of an effort for Large Displacement UUV (LD UUV) - Naval Forces UUV Development that will create critical technology for Long Endurance LDUUV to meet 30+ days.<br><br>***FY 2013 Accomplishments:***<br>N/A<br><br>***FY 2014 Plans:***<br>N/A<br><br>***FY 2015 Plans:***<br>- Initiate the development and demonstrate Autonomy technology that will the ability to avoid undersea static obstacles, operate in a variety of currents, and adapt to local environment to maintain station..<br><br>- Initiate Endurance technology that will Develop and demonstrate Endurance technology that will investigate new reliability strategy to operate for 30 days. | | | |
| **Accomplishments/Planned Programs Subtotals** | - | - | 9.985 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603747N / *Undersea Warfare Advanced Tech* | **Project (Number/Name)**<br>2916 / *Undersea Warfare Advanced Technology* |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**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.
- 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.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | R-1 Program Element (Number/Name)<br>PE 0603747N / *Undersea Warfare Advanced Tech* | Project (Number/Name)<br>9999 / *Congressional Adds* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9999: *Congressional Adds* | - | 9.164 | - | - | - | - | - | - | - | - | - | 9.164 |

# The FY 2015 OCO Request will be submitted at a later date.

**A. Mission Description and Budget Item Justification**

Congressional Interest Items not included in other Projects.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 |
|---|---|---|
| ***Congressional Add:*** ASW Research Prog - Cong | 9.164 | - |
| ***FY 2013 Accomplishments:*** Provides opportunities for field development and field trials of passive acoustic and non-acoustic sensing approaches. Field efforts will involve use of Navy owned oceanographic ships. | | |
| ***FY 2014 Plans:*** N/A | | |
| **Congressional Adds Subtotals** | 9.164 | - |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

Congressional Interest Items not included in other Projects.

THIS PAGE INTENTIONALLY LEFT BLANK

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | | | | | R-1 Program Element (Number/Name)<br>PE 0603758N *I Navy Warfighting Exp & Demo* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | 45.801 | 51.463 | 53.956 | - | 53.956 | 92.525 | 94.602 | 137.807 | 137.821 | Continuing | Continuing |
| 2918: *Navy Warfighting Experiments and Demo* | 0.000 | 45.801 | 51.463 | 53.956 | - | 53.956 | 92.525 | 94.602 | 137.807 | 137.821 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 rapid prototypes and provides them to the warfighter for experimentation during laboratory and operational demonstrations; (3) TechSolutions develops rapid response science and technology prototypes addressing Fleet/Force needs identified by Sailors and Marines at the deckplate level; (4) Operations Analysis provides the Navy and Marine Corps the means to identify capability needs that can be addressed with science and technology solutions, and (5) Manufacturing Technology Science and Technology (S&T) to accelerate recently discovered manufacturing technologies to reduce the acquisition and ownership costs of current and future platforms.

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 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO | FY 2015 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 51.819 | 51.463 | 53.701 | - | 53.701 |
| Current President's Budget | 45.801 | 51.463 | 53.956 | - | 53.956 |
| Total Adjustments | -6.018 | - | 0.255 | - | 0.255 |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | -0.267 | - | | | |
| • SBIR/STTR Transfer | -1.631 | - | | | |
| • Program Adjustments | - | - | 0.278 | - | 0.278 |
| • Rate/Misc Adjustments | 0.001 | - | -0.023 | - | -0.023 |
| • Congressional General Reductions Adjustments | -4.121 | - | - | - | - |

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | Date: March 2014 |
|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | **R-1 Program Element (Number/Name)**<br>PE 0603758N *I Navy Warfighting Exp & Demo* |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | R-1 Program Element (Number/Name)<br>PE 0603758N / *Navy Warfighting Exp & Demo* | Project (Number/Name)<br>2918 / *Navy Warfighting Experiments and Demo* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2918: *Navy Warfighting Experiments and Demo* | - | 45.801 | 51.463 | 53.956 | - | 53.956 | 92.525 | 94.602 | 137.807 | 137.821 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** NAVAL WARFARE EXPERIMENTATION | 16.970 | 19.119 | 19.719 |
| ***Description:*** 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.<br><br>***FY 2013 Accomplishments:***<br>- Continued concept based technology program efforts.<br>- Continued experimentation efforts with technologies developed in SwampWorks/TechSolutions.<br>- Continued to identify promising technology breakthroughs that can be prototyped and delivered to the warfighter for experimentation.<br>- Continued development and demonstration of real time situational awareness technologies.<br>- Continued technology experimentation for Total Ownership Cost (TOC) reduction.<br>- Continued efforts to develop and demonstrate technologies to meet current or emerging operational needs.<br>- Initiated efforts to experiment and demonstrate technologies to meet current or emerging operational needs.<br><br>***FY 2014 Plans:***<br>- Continue efforts initiated in FY 2013 as necessary<br>- Develop, demonstrate and experiment with technologies to rapidly evaluate operational capabilities of new or recently developed technologies.<br><br>***FY 2015 Plans:***<br>- Continue efforts initiated in FY 2014 as necessary<br>- Develop, demonstrate and experiment with technologies to rapidly evaluate operational capabilities of new or recently developed technologies. | | | |
| ***Title:*** OPERATIONS ANALYSIS | 2.409 | 2.714 | 2.096 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603758N / *Navy Warfighting Exp & Demo* | **Project (Number/Name)**<br>2918 / *Navy Warfighting Experiments and Demo* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Description:*** 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 S&T solutions. The effort includes core analysis of S&T programs, military utility/capability gaps analyses, war gaming, structured experimentation events, the articulation of the results of that analysis and wargaming, and the development of innovation strategies and messages resulting from these analyses. Recent work includes participation in SIMEX design, data collection and analysis events; wargame design in support of the ONR Office of Technology; analytical, strategic planning, and wargaming support; organizing and conducting workshops and symposia that increase innovation outreach; and participating in Red Teaming and conceptual analysis.<br><br>***FY 2013 Accomplishments:***<br>- Continued to conduct Military Utility Analyses of Future Naval Capability technologies.<br>- Continued to conduct capability gaps analyses to identify areas that can be addressed with products from the S&T portfolio.<br>- Continued to conduct SIMEX development, execution, data collection and analysis.<br>- Continued to conduct wargame design in support of the ONR Office of Technology.<br><br>***FY 2014 Plans:***<br>- Continue all FY 2013 efforts.<br><br>***FY 2015 Plans:***<br>- Continue all FY 2014 efforts | | | |
| ***Title:*** SWAMPWORKS<br><br>***Description:*** 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).<br><br>The funding increase from FY 2014 to FY 2015 is largely due to the increased research and fleet interest in the areas of Autonomy, Electromagnetic Warfare and the exploitation of unmanned vehicles.<br><br>***FY 2013 Accomplishments:***<br>- Continued to identify enduring and emergent operational barriers identified by naval leadership and responded with relevant technology developments and demonstrations.<br>- Continued disruptive commercial technology studies at varied military, government, and educational institutions.<br>- Continued high risk/high payoff projects to explore significantleap-ahead capabilities .<br>- Continued efforts to develop technologies to meet current or emerging operational needs. | 16.337 | 18.305 | 20.246 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603758N / *Navy Warfighting Exp & Demo* | **Project (Number/Name)**<br>2918 / *Navy Warfighting Experiments and Demo* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| - Continued investment in submarine control surface technologies.<br>- Continued investment in advanced electronic warfare technologies; projects are expected to be classified at a higher level.<br>- Initiated efforts to develop and demonstrate technologies to meet current or emerging operational needs to include vision enhancement, electronic warfare, diving technologies.<br>***FY 2014 Plans:***<br>- Continue FY 2013 efforts as necessary.<br>- Initiate efforts that develop and/or demonstrate advanced technologies in support of Fleet issue in an accelerated timeframe.<br>***FY 2015 Plans:***<br>- Continue FY 2014 efforts as neccessary.<br>- Initiate efforts that develop and/or demonstrate advanced technologies in support of Fleet issue in an accelerated timeframe. | | | |
| ***Title:*** TECH SOLUTIONS<br>***Description:*** TechSolutions develops rapid response S&T solutions to immediate Fleet/Force needs identified by individual warfighters at the deckplate level. Sailors, Marines and Science Advisors submit their issues throughout the year via the TechSolutions website, email, phone, or chain of command. Projects are initiated as requests come in and are completed in approximately twelve to eighteen months, resulting in a prototype demonstration of TRL 6 or higher.<br>***FY 2013 Accomplishments:***<br>- Continued development of projects that provide solutions to problems identified by Science Advisors and the Fleet/Force to address emergent critical needs.<br>- Developed, demonstrate and deliver technical solution prototypes to projects initiated in the previous fiscal year.<br>- Initiated development of additional projects that will provide solutions to address emergent critical needs.<br>***FY 2014 Plans:***<br>- Develop, demonstrate and deliver technical solution prototypes to projects initiated in the previous fiscal year.<br>- Initiate development of additional projects that will provide solutions to address emergent critical needs.<br>***FY 2015 Plans:***<br>- Develop, demonstrate and deliver technical solution prototypes to projects initiated in the previous fiscal year.<br>- Initiate development of additional projects that will provide solutions to address emergent critical needs. | 8.403 | 9.469 | 9.756 |
| ***Title:*** MANUFACTURING TECHNOLOGY S&T<br>***Description:*** The Manufacturing Technology S&T program accelerates recently discovered manufacturing technologies to reduce the acquisition and ownership costs of current and future platforms which assists in meeting performance and platform | 1.682 | 1.856 | 2.139 |

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603758N / *Navy Warfighting Exp & Demo* | **Project (Number/Name)**<br>2918 / *Navy Warfighting Experiments and Demo* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| affordability goals - both acquisition and life-cycle. This supports a critical goal of the Navy, meeting the affordability goals of major acquisition platforms, by accelerating emerging manufacturing technology. Funding does not begin until FY 2013.<br><br>***FY 2013 Accomplishments:***<br>- Initiated/accelerated recently discovered manufacturing technologies to reduce the acquisition and ownership costs of current and future platforms.<br>***FY 2014 Plans:***<br>- Continue manufacturing technology development efforts of FY 2013 to reduce the acquisition and ownership costs of current and future platforms.<br>***FY 2015 Plans:***<br>- Continue manufacturing technology development efforts of FY 2014 to reduce the acquisition and ownership costs of current and future platforms. | | | |
| **Accomplishments/Planned Programs Subtotals** | 45.801 | 51.463 | 53.956 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**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. 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 LOEs 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.

| Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy | | | | | | | | | | | Date: March 2014 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | | | | | R-1 Program Element (Number/Name)<br>PE 0603782N *I Mine and Expeditionary Warfare Advanced Technology* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO #** | **FY 2015 Total** | **FY 2016** | **FY 2017** | **FY 2018** | **FY 2019** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 0.000 | - | 2.000 | 2.000 | - | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | Continuing | Continuing |
| 2917: *Shallow Water MCM Demos* | 0.000 | - | 2.000 | 2.000 | - | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**Note**

FY 2013 funding associated with Future Naval Capability (FNC) efforts are transferring to a new Program Element titled Future Naval Capabilities Advanced Technology Development (PE 0603673N). This is to enhance the visibility of the FNC Program by providing an easily navigable overview of all 6.3 FNC investments in a single location.

**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 (Sep 2011). 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, RDT&E Budget Item Justification: PB 2015 Navy | | | | | Date: March 2014 |
|---|---|---|---|---|---|
| **Appropriation/Budget Activity**<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)* | | | **R-1 Program Element (Number/Name)**<br>PE 0603782N *I Mine and Expeditionary Warfare Advanced Technology* | | |
| **B. Program Change Summary ($ in Millions)** | **FY 2013** | **FY 2014** | **FY 2015 Base** | **FY 2015 OCO** | **FY 2015 Total** |
| Previous President's Budget | - | 2.000 | - | - | - |
| Current President's Budget | - | 2.000 | 2.000 | - | 2.000 |
| Total Adjustments | - | - | 2.000 | - | 2.000 |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | - | - | | | |
| • SBIR/STTR Transfer | - | - | | | |
| • Program Adjustments | - | - | 2.000 | - | 2.000 |
| • Rate/Misc Adjustments | - | - | - | - | - |

**Change Summary Explanation**

Technical: Not applicable.

Schedule: Not applicable.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | | Date: March 2014 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 3 | R-1 Program Element (Number/Name)<br>PE 0603782N / *Mine and Expeditionary Warfare Advanced Technology* | Project (Number/Name)<br>2917 / *Shallow Water MCM Demos* | |

| COST ($ in Millions) | Prior Years | FY 2013 | FY 2014 | FY 2015 Base | FY 2015 OCO # | FY 2015 Total | FY 2016 | FY 2017 | FY 2018 | FY 2019 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2917: *Shallow Water MCM Demos* | - | - | 2.000 | 2.000 | - | 2.000 | 2.000 | 2.000 | 2.000 | 2.000 | Continuing | Continuing |

# The FY 2015 OCO Request will be submitted at a later date.

**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 Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| ***Title:*** MINE/OBSTACLE DETECTION | - | 2.000 | 2.000 |

***Description:*** 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 Beach Zone (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 Surf Zone (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 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.

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603782N / *Mine and Expeditionary Warfare Advanced Technology* | **Project (Number/Name)**<br>2917 / *Shallow Water MCM Demos* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2013 | FY 2014 | FY 2015 |
|---|---|---|---|
| Funding increase from FY 2013 to FY 2014 due to the initiation of a laser interfermetric sensor/system that can be integrated onto various platforms including EOD robots for detection and/or diagnosis of buried objects. Highly dexterous dual manipulator systems will also be initiated in FY14 that can be integrated onto EOD robots for precision render safe and neutralization missions.<br><br>***FY 2013 Accomplishments:***<br>N/A<br><br>***FY 2014 Plans:***<br>- Initiate development of a laser interferometric sensor/system that can be integrated onto various platforms including EOD robots for detection and/or diagnosis of buried objects.<br>- Initiate development of highly dexterous dual manipulator systems (manipulators, controllers) that can be integrated onto EOD robots for precision render safe and neutralization missions.<br>- Initiate development of a Resonance Raman (single or dual wavelength) detector for standoff detection of trace explosives that can be integrated into a handheld device or onto an EOD robot.<br><br>***FY 2015 Plans:***<br>- Continue all efforts not noted as completed for FY14. | | | |
| **Accomplishments/Planned Programs Subtotals** | - | 2.000 | 2.000 |

**C. Other Program Funding Summary ($ in Millions)**

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**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

| Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy | | Date: March 2014 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 3 | **R-1 Program Element (Number/Name)**<br>PE 0603782N / *Mine and Expeditionary Warfare Advanced Technology* | **Project (Number/Name)**<br>2917 / *Shallow Water MCM Demos* |

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