| Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Navy | | | | | | | | | | | Date: May 2017 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 4: *Advanced Component Development & Prototypes (ACD&P)* | | | | | R-1 Program Element (Number/Name)<br>PE 0603562N *I Submarine Tactical Warfare Sys* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2016** | **FY 2017** | **FY 2018 Base** | **FY 2018 OCO** | **FY 2018 Total** | **FY 2019** | **FY 2020** | **FY 2021** | **FY 2022** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 70.124 | 10.172 | 8.782 | 13.834 | - | 13.834 | 9.545 | 11.448 | 11.680 | 11.910 | Continuing | Continuing |
| 0770: *Adv Sub Supp Equip Prog* | 19.698 | 4.051 | 4.429 | 4.155 | - | 4.155 | 4.396 | 4.717 | 4.821 | 4.919 | Continuing | Continuing |
| 1739: *Submarine Arctic W/F Development* | 50.426 | 6.121 | 4.353 | 9.679 | - | 9.679 | 5.149 | 6.731 | 6.859 | 6.991 | Continuing | Continuing |

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

Project 0770 - The Advanced Submarine Support Equipment Program (ASSEP) objective is to improve submarine operational effectiveness through the development and implementation of advanced Research and Development (R&D). In order to provide improved operational effectiveness, R&D efforts are focused on Advanced Imaging Developments and Advanced Electronic Warfare Support (ES) Developments. A continuing need exists to improve these capabilities in view of the advancements in potential imaging counter detection, the need to support specialized missions, and the increasingly dense and sophisticated electronic environment caused by the proliferation of complex radar, communications, and navigation equipment of potential adversaries. Ongoing developments in 360 degree imaging systems and electro-optic infra-red vulnerability signature reduction technologies are supporting these needs.

Project 1739 - The Submarine Arctic Warfare Development Project responds to the increased threat of naval activity in the Arctic regions while continuously supporting the Navy's strategic objective of Assured Access and Combat Credibility. The U.S. Navy Submarine Force (SUBFOR) demonstrates existing Arctic Warfare capabilities, and operational and tactical proficiency, while developing advanced submarine research and development technology in unique cold water environments, under-ice conditions, and ice-covered shallow water regions during Ice Exercises (ICEX). Tactical Development (TACDEV) ICEXs are conducted biennially and require up front comprehensive planning and work-up training, as well as post exercise analysis and reporting. ICEXs provide the framework for various submarine research and development programs to conduct test and evaluation in Arctic regions or at periodic Ice Camps. Particular emphasis is placed on the areas of sonar operability, tactical surveillance, weapon utility, and other submarine support missions. Efforts include assessment of combat system effectiveness, development of Arctic specific improvements for existing sonar and weapons, development of class-specific Arctic operational guidelines, and the testing of ice-capable submarine support structures.

Major ICEXs, occurring every four (4) years (FY 2018, FY 2022, etc) include a Fleet requirement to conduct exercise torpedo (EXTORP) firings in the Arctic. A Torpedo Exercise (TORPEX) requires significantly higher level of logistics, personnel, and infrastructure to account for the recovery and transportation efforts of the EXTORPs.

This Project also provides SUBFOR a cadre of trained Arctic Operation Specialists (AOS) and an inventory of unique Arctic sensors to optimize submarine safety during under-ice operations.

| Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Navy | | | | | Date: May 2017 |
|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319: *Research, Development, Test & Evaluation, Navy I* BA 4: *Advanced Component Development & Prototypes (ACD&P)* | | R-1 Program Element (Number/Name)<br>PE 0603562N *I Submarine Tactical Warfare Sys* | | | |
| **B. Program Change Summary ($ in Millions)** | **FY 2016** | **FY 2017** | **FY 2018 Base** | **FY 2018 OCO** | **FY 2018 Total** |
| Previous President's Budget | 10.371 | 8.782 | 13.863 | - | 13.863 |
| Current President's Budget | 10.172 | 8.782 | 13.834 | - | 13.834 |
| Total Adjustments | -0.199 | 0.000 | -0.029 | - | -0.029 |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | - | - | | | |
| • SBIR/STTR Transfer | -0.200 | 0.000 | | | |
| • Rate/Misc Adjustments | 0.001 | 0.000 | -0.029 | - | -0.029 |

| Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy | | | Date: May 2017 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 4 | R-1 Program Element (Number/Name)<br>PE 0603562N / *Submarine Tactical Warfare Sys* | Project (Number/Name)<br>0770 / *Adv Sub Supp Equip Prog* | |

| COST ($ in Millions) | Prior Years | FY 2016 | FY 2017 | FY 2018 Base | FY 2018 OCO | FY 2018 Total | FY 2019 | FY 2020 | FY 2021 | FY 2022 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0770: *Adv Sub Supp Equip Prog* | 19.698 | 4.051 | 4.429 | 4.155 | - | 4.155 | 4.396 | 4.717 | 4.821 | 4.919 | Continuing | Continuing |
| Quantity of RDT&E Articles | | - | - | - | - | - | - | - | - | - | | |

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

A continuing need exists to improve Imaging and Electronic Warfare support (EW) capabilities in view of the advancements in potential imaging counter detection and the increasingly dense electromagnetic environment caused by the proliferation of complex radar, communications, and navigation equipment of potential adversaries. Improvements are necessary for submarine EW and Imaging to be operationally effective in the following mission areas: Joint Littoral Warfare, Joint Surveillance, Space and Electronic Warfare, Intelligence Collection, Maritime Protection, and Joint Strike. The program is divided into two project categories: Advanced Imaging Project Development and Advanced Electronic Warfare Support Project Development. Both of these categories will allow for the mitigation of submarine masts, periscopes, and sensors to visual, radar, and infrared detection. Evaluation of state of the art technology to implement periscope/mast improvements via EW electromagnetic and electro-optic sensors results in improved capability. Engineering Demonstration Models (EDMs) are developed, evaluated, and validated in the lab and through at-sea testing.

The Advanced Imaging Project Development projects include the development of the Affordable Modular Panoramic Photonics Mast (AMPPM) which is the prototype for the Tactically Oriented Technology Insertion Mast (TOTIM), that introduces several groundbreaking technologies such as individually replaceable capability modules (allowing a vast array of capability combinations without requiring redesign) as well as presenting live 360 degree High Definition video (greatly increasing situational awareness and reducing scope exposure time.) Also in support of the Advance Imaging Project Development are; Automatic Aircraft Cueing, RF Vulnerability Reduction (RAS), ONR Vulnerability Assessment Tools, GPS Denied Navigation, Meteorological Sensors (METOC), Passive Ranging Testing, RIF - Spinel Hyper - hemisphere, Anti reflective Coating Spherical Domes, Volumetric Atmospheric Modeling, Low Power Fiber Delivered Laser Range Finder (planned), Reduced Cost Fabrication of Optical Sapphire Hyper-hemispheres (planned), Navy Tactical Cloud Integration (planned), Offboard Sensor Suite (planned), Imaging Buoy (planned), and a Project Arrangement (PA) with Australia covering Electromagnetic Spectrum Sensor System Simulation & Development for model-based mission planning and a Coalition Warfare Program (CWP) covering periscope vulnerability.
The Advanced EW Development projects include the development of: Enhanced DeInterleavers, Low Probability of Intercept (LPI) Direction Finding (DF), High Speed Network, Embedded Built-in Test (BIT), EW on-Board Trainer (OBT), Digital EWP, Extremely Wideband Digital Receiver (NATO Nunn Project with NAVAIR and Australia), Multi-function Modular Mast (MMM) Payloads, Digital Precision Direction Finding, Multi-Functional Apertures, disposable decoy, ISR and tethered Buoys and Antennas, RF over Fiber (RFoF), Human Machine Interface (HMI)Improvements, and Next Generation EW Systems Algorithms and Applications. New in FY17 is the acceleration of support for an EW Disposable Decoy Buoy capability addressing the U.S. Navy Submarine Force (SUBFOR) requirement to provide a Submarine Launched Decoy Buoy.

All programs funded in this project are non-Acquisition Category (ACAT) programs. The test articles identified consist of critical components that will be fully developed during Engineering Manufacturing and Development phase into EDMs.

| Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy | | Date: May 2017 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603562N / *Submarine Tactical Warfare Sys* | **Project (Number/Name)**<br>0770 / *Adv Sub Supp Equip Prog* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2016 | FY 2017 | FY 2018 Base | FY 2018 OCO | FY 2018 Total |
|---|---|---|---|---|---|
| ***Title:*** Advanced Imaging Project Development | 2.644 | 3.247 | 2.874 | 0.000 | 2.874 |
| ***Articles:*** | - | - | - | - | - |
| ***FY 2016 Accomplishments:*** | | | | | |
| 360 Imaging TOTIM Image Processing Development | | | | | |
| RF Vulnerability Reduction (RAS) Lab Test | | | | | |
| Automatic Aircraft Cueing Lab Test | | | | | |
| GPS Denied Navigation Continued Development | | | | | |
| Submarine METOC Continued Development | | | | | |
| CWP Periscope Vulnerability Lab Test/At-Sea Test | | | | | |
| PA Electromagnetic Spectrum Sensor System Simulation Development | | | | | |
| Low Power Fiber Delivered Laser Range Finder Development | | | | | |
| Reduced Cost Fabrication of Optical Sapphire Hyper-hemispheres Development | | | | | |
| ***FY 2017 Plans:*** | | | | | |
| TOTIM Land Based ISIS Testing | | | | | |
| RF Vulnerability Reduction (RAS) Lab Test | | | | | |
| Automatic Aircraft Cueing Lab Test | | | | | |
| SBIR- Passive Ranging Development | | | | | |
| GPS Denied Navigation Testing | | | | | |
| Meteorological Sensors Testing | | | | | |
| Low Power Fiber Delivered Laser Range Finder Continued Development | | | | | |
| Reduced Cost Fabrication of Optical Sapphire Hyper-hemispheres Continued Development | | | | | |
| Anti - reflective Coating Spherical Domes Development | | | | | |
| Volumetric Atmospheric Modeling Development | | | | | |
| PA Electromagnetic Spectrum Sensor System Simulation Development | | | | | |
| ***FY 2018 Base Plans:*** | | | | | |
| 360 Degree Imaging TOTIM Development | | | | | |
| Automatic Aircraft Cueing Lab Test | | | | | |
| GPS Denied Navigation Lab Test | | | | | |
| Meteorological Sensors Testing | | | | | |
| Low Power Fiber Delivered Laser Range Finder Lab Test | | | | | |
| Reduced Cost Fabrication of Optical Sapphire Hyper-hemispheres Lab Test | | | | | |

| Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy | | Date: May 2017 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603562N / *Submarine Tactical Warfare Sys* | **Project (Number/Name)**<br>0770 / *Adv Sub Supp Equip Prog* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2016 | FY 2017 | FY 2018 Base | FY 2018 OCO | FY 2018 Total |
|---|---|---|---|---|---|
| Anti - reflective Coating Spherical Domes Development<br>Volumetric Atmospheric Modeling Development<br>Navy Tactical Cloud Integration Development<br>PA Electromagnetic Spectrum Sensor System Simulation Development<br>***FY 2018 OCO Plans:***<br>N/A | | | | | |
| ***Title:*** Advanced Electronic Warfare Support (EW) Project Development | 1.407 | 1.182 | 1.281 | 0.000 | 1.281 |
| ***Articles:*** | - | - | - | - | - |
| ***FY 2016 Accomplishments:***<br>ES On-Board Trainer (OBT) Development<br>Enhanced DeInterleavers Lab Demo # 2<br>Human Machine Interface (HMI) Continued Development<br>LPI DF/Localization Lab Test<br>Digital Early Warning Receiver (EWR) Development<br>Extremely Wideband Digital Receiver Development<br>EW Digital Direction Finding Development<br>Next Gen EW System Development<br>MMM Payload (CEAS) Development<br>Disposable Buoy - Submarine Launched Decoy baseline Lab Test<br>Disposable Buoy - Modular Expendable Decoy enhancements Development<br>Disposable Buoy - Modular Expendable Intelligence Surveillance and reconnaissance (ISR) Development<br>Tethered Buoy- Modular Tethered Antenna Development<br>Tethered Buoy - Radio Frequency over Fiber (RFoF) development | | | | | |
| ***FY 2017 Plans:***<br>ES OBT Test<br>Enhanced DeInterleavers Pierside/MTV Test<br>LPI DF/Localization Pierside / MTV Test<br>MMM (CEAS) Lab Test<br>Precision DF Lab Test<br>Disposable Buoy - Submarine Launched Decoy Baseline Lab Test | | | | | |
| ***FY 2018 Base Plans:*** | | | | | |

| Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy | | Date: May 2017 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603562N / *Submarine Tactical Warfare Sys* | **Project (Number/Name)**<br>0770 / *Adv Sub Supp Equip Prog* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2016 | FY 2017 | FY 2018 Base | FY 2018 OCO | FY 2018 Total |
|---|---|---|---|---|---|
| ES OBT Lab Demo<br>Enhanced DeInterleavers Lab Test<br>Human Machine Interface (HMI) Lab Demo<br>LPI DF Lab Test<br>EWP Phase II Development<br>Extremely Wideband Digital Receiver Development<br>EW Digital Direction Finding Development<br>MMM (CEAS) Development<br>Disposable Buoy Modular Expendable Decoy enhancements - Development S&T<br>Disposable Buoy Modular Expendable Intelligence Surveillance and reconnaissance (ISR) Development S&T<br>Tethered Buoy Modular Tethered Antenna Development S&T<br>Tethered Buoy Radio Frequency over Fiber (RFoF) Development S&T<br>***FY 2018 OCO Plans:***<br>N/A | | | | | |
| **Accomplishments/Planned Programs Subtotals** | 4.051 | 4.429 | 4.155 | 0.000 | 4.155 |

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

N/A

**Remarks**

**D. Acquisition Strategy**

This project optimizes technology insertion using a build-test-build approach to support EW and Imaging operational needs. Operational needs have been based on the tactical requirements identified in the Common Submarine Imaging System (CSIS) (CDD# 849-87-11) dtd 22 Dec 2011 for Submarine Imaging Systems, and the Common Submarine Electronic Warfare System (CSEWS) (CDD# 907-97-16) dtd 27 Sep 2016 for the Electronic Warfare Systems. Project efforts develop submarine unique improvements to mast, periscope, and EW electromagnetic spectrum and electro-optic sensors based on emerging technologies that are available from DoD Exploratory Development Programs, industry Independent Research and Development, and other sources. Engineering Demonstration Models (EDMs) will be developed to provide a realistic method of evaluating the improvements, including deployment on submarines for testing.

**E. Performance Metrics**

The RDD program goal is to respond to urgent operational needs within 30 days and provide for rapid development and fielding of prototype solutions within 270 days.

| Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy | | | Date: May 2017 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 4 | R-1 Program Element (Number/Name)<br>PE 0603562N / *Submarine Tactical Warfare Sys* | Project (Number/Name)<br>1739 / *Submarine Arctic W/F Development* | |

| COST ($ in Millions) | Prior Years | FY 2016 | FY 2017 | FY 2018 Base | FY 2018 OCO | FY 2018 Total | FY 2019 | FY 2020 | FY 2021 | FY 2022 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1739: *Submarine Arctic W/F Development* | 50.426 | 6.121 | 4.353 | 9.679 | - | 9.679 | 5.149 | 6.731 | 6.859 | 6.991 | Continuing | Continuing |
| Quantity of RDT&E Articles | | - | - | - | - | - | - | - | - | - | | |

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

The Submarine Arctic Warfare Development Project responds to the increased threat of submarine and surface ship activity in Arctic regions of the world through the development of advanced submarine concepts. It places particular emphasis on submarine operability and mission support in unique, cold, ice-covered environments. Efforts include assessment of combat system effectiveness, weapons testing, use of High Frequency (HF) sonars in Arctic regions, testing of ice-capable submarine structures, and development of class-specific Arctic operational guidelines. This project also provides the framework for various research and development programs to conduct test and evaluation in shallow water and Arctic regions.

Increase in FY18 funding ($+5.367M) is to fund the FY18 major TACDEV/TORPEX ICEX that requires additional aviation, personnel, logistics, and torpedo recovery resources than a non-firing (TACDEV only) ICEX.

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2016 | FY 2017 | FY 2018 Base | FY 2018 OCO | FY 2018 Total |
|---|---|---|---|---|---|
| ***Title:*** Conduct ICEX and Arctic Transit Mission, ICEX Workup and Training, Ice Camps | 6.121 | 4.353 | 9.679 | 0.000 | 9.679 |
| ***Articles:*** | - | - | - | - | - |
| ***FY 2016 Accomplishments:***<br>Conducted Arctic work-up training on 10 submarines, completed the ICEX 2016 mission, and Ice Camp in support of ICEX 2016. Supported 6 Arctic deployments, including one inter-Fleet transfer, as directed by the SUBFOR Commanders. Investigated and deployed new systems for Arctic submarine support. Supported testing and Tactical Development (TACDEV) required to improve submarine Arctic operability and warfighting. | | | | | |
| ***FY 2017 Plans:***<br>Conduct Arctic work-up training. Support Arctic deployments, including inter-Fleet transfers, as required by the SUBFOR Commanders. Investigate, research, develop and deploy new systems for Arctic submarine support. Support testing and tactical development required to improve submarine Arctic operability and warfighting. Initiate planning for ICEX mission 1-2018 and Ice Camp 1-2018. | | | | | |
| ***FY 2018 Base Plans:***<br>Conduct Arctic work-up training, ICEX mission 1-2018, and Ice Camp 1-2018. | | | | | |

| Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy | | Date: May 2017 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603562N / *Submarine Tactical Warfare Sys* | **Project (Number/Name)**<br>1739 / *Submarine Arctic W/F Development* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2016 | FY 2017 | FY 2018 Base | FY 2018 OCO | FY 2018 Total |
|---|---|---|---|---|---|
| Conduct ICEX 2018 as a TACDEV and TORPEX event. Operate a submarine and torpedo tracking range for approximately 14 days, conduct diver recovery of EXTORPs trapped under-ice, helicopter recover to Ice Camp, backhaul and conduct end or run analysis with on-ice support, return airlift EXTORPs from the Ice Camp back to shore for flushing and return ground transport from Alaska back to Naval Undersea Warfare Center (NUWC), Newport, RI. Support Arctic deployments, including inter-Fleet transfers, as required by the SUBFOR Commanders. Investigate, research, develop and deploy new systems for Arctic submarine support. Support testing and tactical development required to improve submarine Arctic operability and warfighting.<br>***FY 2018 OCO Plans:***<br>N/A | | | | | |
| **Accomplishments/Planned Programs Subtotals** | 6.121 | 4.353 | 9.679 | 0.000 | 9.679 |

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

N/A

**Remarks**

**D. Acquisition Strategy**

- Use NAVSEA University Affiliated Research Center (UARC) omnibus contract for procurement of an acoustic tracking range service and equipment to support ICEX Ice Camps.
- Use sole source and competitively awarded contracts through the U.S. Army Corps of Engineers (USACE) Alaska regional office for ICEX Ice Camp logistics, engineering, and operations support.
- Use sole source and competitively awarded contracts through the Fleet Logistics Center (FLC) regional contracting office and Defense Logistics Agency (DLA) for equipment procurement and technical services.

**E. Performance Metrics**

Conduct and support Arctic deployments, including inter-Fleet transfers and biennial ICEXs, as required by the SUBFOR Commanders.