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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Exhibit R-2**, **RDT&E Budget Item Justification:** PB 2019 Navy | | | | | | | | | | **Date:** February 2018 | | |

| **Appropriation/Budget Activity** 1319: *Research, Development, Test & Evaluation, Navy I* BA 4: *Advanced Component Development & Prototypes (ACD&P)* | **R-1 Program Element (Number/Name)** PE 0603561N *I Advanced Submarine System Development* |
|---|---|

| COST ($ in Millions) | Prior Years | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total | FY 2020 | FY 2021 | FY 2022 | FY 2023 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Program Element | 933.435 | 120.289 | 100.955 | 109.086 | - | 109.086 | 113.460 | 107.884 | 105.832 | 111.793 | Continuing | Continuing |
| 0223: *Sub Combat System Improvement (ADV)* | 485.968 | 40.626 | 40.828 | 47.118 | - | 47.118 | 49.531 | 51.708 | 51.954 | 53.053 | Continuing | Continuing |
| 2033: *Adv Submarine Systems Development* | 447.467 | 51.684 | 35.795 | 30.685 | - | 30.685 | 32.589 | 34.917 | 34.923 | 35.774 | Continuing | Continuing |
| 2096: *Payload Delivery Development* | 0.000 | 3.800 | 15.738 | 22.956 | - | 22.956 | 22.887 | 12.659 | 10.188 | 14.012 | Continuing | Continuing |
| 3391: *SSN/SSGN Survivability Program* | 0.000 | 0.000 | 8.594 | 8.327 | - | 8.327 | 8.453 | 8.600 | 8.767 | 8.954 | Continuing | Continuing |
| 9999: *Congressional Adds* | 0.000 | 24.179 | 0.000 | 0.000 | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 24.179 |

### A. Mission Description and Budget Item Justification

This program element supports innovative research and development in submarine Hull, Mechanical and Electrical (HM&E) and combat systems technologies and the subsequent evaluation, demonstration, and validation for submarine platforms. It will increase the submarine technology base and provide subsystem design options not currently feasible. The program element also supports programs transitioning from Science and Technology (S&T), Defense Advanced Research Projects Agency (DARPA), Independent Research and Development, and Small Business Innovation Research (SBIR) projects.

Project 0223: The Submarine Combat System Improvement (Advanced) (Non-ACAT) Project researches, develops, and tests new sonar, combat system, imaging, and electronic warfare software and develops, tests, and prototypes new sonar arrays for Program Executive Office Submarine (PEO SUB) programs, delivering about thirty (30) new capabilities every other year.  This Project supports Navy Submarine Acoustic Superiority and Technology Insertion Initiatives through the application of advanced development and testing of sensors and sensor processing systems supporting tactical control systems improvements. Improvements are supportive of A Cooperative Strategy for 21st Century Sea Power and the Chief of Naval Operations (CNO) Design for Maintaining Maritime Superiority; addressing all components to include Strengthen Naval Power At and From Sea, Achieve High Velocity Learning, Strengthen Our Navy Team for the Future, and Expand and Strengthen Our Network of Partners. This Project addresses threats posed by China, Russia, Iran, Korea and Terrorism (CRIKT), improved lethality of U.S. Submarine Forces and 3rd Offset Capabilities in the Unmanned and Automated Systems domains.

Project 0223 is comprised of three major efforts: Advanced Processing Builds (APB), Flank Array Demonstration, and Advanced Sensors.

APB develops, tests and transitions capabilities for:
- APB Acoustics, transitioning to AN/BQQ-10
- APB Tactical Control, transitioning to AN/BYG-1
- APB Imaging, transitioning to AN/BVY-1

| **Exhibit R-2**, **RDT&E Budget Item Justification:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **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 0603561N *I Advanced Submarine System Development* | |

- APB Electronic Warfare (EW), transitioning to AN/BLQ-10

Flank Array Demonstration develops signal processing, integrates improvements and conducts testing and analysis for large array configurations. Improvements are transitioned to PEO SUB for fielding on the Virginia Class submarines.

Advanced Sensors develops new technologies for Hull Mounted and Towed Arrays. Hull Mounted improvements support submarine applications only. Towed array improvements are shared to support surface and surveillance applications, as well.

Project 2033:
The Advanced Submarine Systems Development (ASSD) Program is a non-acquisition program that develops and matures technologies for successful integration into future and modernized submarine classes, thus lowering acquisition and life cycle program costs while improving mission capability. ASSD transitions Hull, Mechanical, and Electrical (HM&E) technologies and future naval concepts from Science & Technology (S&T) and Research and Development (R&D) to operational platforms; performs tests and demonstrates submarine design and naval architecture products destined for integration into future submarine classes or backfit into existing fleet assets; develops, initially integrates, and does test validation of leading payload concepts for submarine integration in support of the Design for Undersea Warfare; and operates unique R&D experimentation, modeling, testing and simulation facilities to enhance submarine stealth, maneuverability, capability, and affordability. The program also supports Small Business Innovation Research (SBIR), Small Business Technology Transfer (STTR), Office of Naval Research (ONR), Defense Advanced Research Projects Agency (DARPA) programs, and near and mid-term technology insertion to achieve future submarine class total ownership cost reductions, and influence future submarine concept designs and core technologies. Experimentation and demonstration is conducted in a joint warfighting context with other services, (i.e. the U.S. Marines, U.S. Army, and the U.S. Air Force), to enable early assessment of warfighting capabilities, and to contribute to smarter technology selection decisions for potential incremental development. This program also supports Information Exchange Programs and joint Project Agreements (PA) with the United Kingdom, Canada, Australia and other international partners.

Project 2033 is comprised of  three budget categories: Strategic Capability Infrastructure, Long Range R&D Investment, Rapid Prototyping.

The major developmental efforts include:

Strategic Capability Infrastructure
- Large Scale Vehicle (LSV)
- Intermediate Scale Measurement System (ISMS)
Long Range R&D Investment
- Advanced Submarine Control (Secondary Propulsion System)
- Advanced Material Propeller (AMP) Technology
- Innovation Technology Transition (SBIRs/STTRs)
- Next Generation Attack Submarine (SSN(X)) Technologies
- Next Generation (NG) Thrust

| **Exhibit R-2**, **RDT&E Budget Item Justification:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **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 0603561N *I Advanced Submarine System Development* | |

- Submarine Signature Management/Acoustic Superiority
- Advanced Hull Coatings
- Next Generation Towed Array Reliability
- Support of ONR Future Naval Capability (FNC) new starts
- Hydraulic Elimination through Electrification
Rapid Prototyping
- Common Unmanned Aerial Vehicle (UAS) Comms
- Fleet Module Autonomous Underwater Vehicle (FMUAV)
- Li-Ion Battery FMAUV Submarine Integration
- Clandestine Delivered Mine (CDM)
- Advanced Weapons Enhanced by Submarine UAS against Mobile targets (AWESUM)/Blackwing Unmanned Aerial System (UAS)
- Submarine Payload Integration
- Electronic Warfare/Intelligence Surveillance and Reconnaissance (EW/ISR) Unmanned Underwater Vehicle (UUV) Payload
- Submarine Launch Decoy

Project 2096:
Payload Delivery Development, consists of two (2) sub-projects:

- Payload Handling System (PHS)
- 3" Sub Launched Unmanned "K" Aerial System (SL-UKAS)

Payload Delivery Development is a non-acquisition program that supports innovative research and development efforts to enable integration of deployable and/or retrievable undersea vehicles, payload concepts, and offboard systems through design, manufacture, test/demonstration, evaluation, and validation for submarine platforms. In addition to technology development, the program will support engineering and integration of new and existing technologies to enable rapid prototyping and fielding of capabilities which will inform and provide solutions to urgent war-fighter needs. Experimentation will be conducted with the Fleet (i.e., Commander, Naval Submarine Forces (COMSUBFOR), Unmanned Undersea Vehicle Squadron One (UUVRON ONE), etc.), enabling an agile environment through at-sea demonstrations, which will provide Fleet and acquisition stakeholders with relevant payload employment data to inform Concepts of Operations (CONOPs) and fielding decisions. The program will furthermore support transition of high-interest systems and/or payloads from research and development to Programs of Record (PoRs), as appropriate.

Project 3391:
SSN/SSGN Survivability Program (S3P) efforts previously funded under project 2033(through FY17) will move to Project 3391 in FY18. S3P addresses gaps in stealth and the survivability for current and future SSN/SSGN force.

| **Exhibit R-2**, RDT&E Budget Item Justification: PB 2019 Navy | | | **Date:** February 2018 | | |
|---|---|---|---|---|---|
| **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 0603561N *I Advanced Submarine System Development* | | |

| **B. Program Change Summary ($ in Millions)** | **FY 2017** | **FY 2018** | **FY 2019 Base** | **FY 2019 OCO** | **FY 2019 Total** |
|---|---|---|---|---|---|
| Previous President's Budget | 106.365 | 100.955 | 114.588 | - | 114.588 |
| Current President's Budget | 120.289 | 100.955 | 109.086 | - | 109.086 |
| Total Adjustments | 13.924 | 0.000 | -5.502 | - | -5.502 |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | - | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | - | - | | | |
| • SBIR/STTR Transfer | -3.378 | 0.000 | | | |
| • Program Adjustments | 0.000 | 0.000 | -3.782 | - | -3.782 |
| • Rate/Misc Adjustments | 0.001 | 0.000 | -1.720 | - | -1.720 |
| • Congressional General Reductions Adjustments | -0.157 | - | - | - | - |
| • Congressional Directed Reductions Adjustments | -7.542 | - | - | - | - |
| • Congressional Add Adjustments | 25.000 | - | - | - | - |

| **Congressional Add Details ($ in Millions, and Includes General Reductions)** | **FY 2017** | **FY 2018** |
|---|---|---|
| **Project:** 9999: *Congressional Adds* | | |
| Congressional Add: *Advanced Materials Propeller Research* | 24.179 | 0.000 |
| Congressional Add Subtotals for Project: 9999 | 24.179 | 0.000 |
| Congressional Add Totals for all Projects | 24.179 | 0.000 |

**Change Summary Explanation**

Funding:

FY 2017: Net PE increase of $13.924M including: $+25.0M for the Advanced Materials Propeller Research Congressional Add; -$7.699M for directed Congressional Adjustments; and -$3.378M for Small Business Innovative Research (SBIR) assessment.
The FY 2019 funding request was reduced by $4.1 million to account for the availability of prior year execution balances.

Project 0223:

| **Exhibit R-2**, **RDT&E Budget Item Justification:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **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 0603561N *I Advanced Submarine System Development* | |

- The net FY 2018 to FY 2019 budget increase of $+6.290M was driven by the requirement to significantly expand APB advanced development efforts. Advancing capabilities of adversary navies require the application of emerging state-of-the-art computing technologies and development of capabilities in non-traditional tactical areas to compliment the core APB domain. The APB development budget, which began with a limited portfolio developing Towed Array Signal Processing improvements, has since expanded over time, and is required to address Hull Arrays, Tactical Control, Tactical Decision Aids, Active Intercept & Receive, Imaging, Operator Interface Modernization, Command Tool Development, and more recently EW. The APB budget increase in FY 2019 is needed to properly resource its breadth of requirements. The increase in APB is provided to establish a needed land-based EW capability development laboratory system; conduct new EW algorithm development; pursue the use of Big Data Analytics; Machine Learning and Artificial Intelligence (AI) computing techniques; develop new automation tools and processing for Unmanned Vehicles; and develop automated tools related to CRIKT. APB development added EW to its portfolio in FY 2017 and initial efforts included establishing a systems engineering approach, hiring national-level Subject Matter Experts (SMEs), and collecting data that will be used to initiate new capability development. Efforts in FY 2019 will build on this foundation with further data collections, system refinements, new capability development, and transition to operational use. The ability of our Submarines to operate covertly in forward areas is challenged by the emergence and wide spread use of modern commercial and military radars that exploit software-defined radio technology and can alter their operating characteristics on-the-fly with the use of a thumb drive. These radars and their waveforms are evolving quickly and are expected to continue to present a rapidly moving target for U.S. EW capabilities to keep pace with. A robust APB EW program is needed to enable our Submarines to continue to operate safely and effectively into the future. The use of modern computing technologies and new automation techniques are required to outpace emerging threat platforms that are rapidly becoming more difficult to detect.  The FY 2019 decrease in the Flank Array Demo (FAD) effort is as originally planned and is based on the focus shift from more costly at-sea testing in FY 2018 to predominantly test result analysis in FY 2019.

The FY 2019 funding request was reduced by $2.000 million to account for the availability of prior year execution balances.

Project 2033:

FY 2017:  Program Adjustments support CNO Speed to Fleet Initiative for ISR/EW UUV and At-sea rapid prototyping, integration, and advanced submarine payloads demonstration. Additionally increase was programmed by CNO for design and procurement of materials for an advanced coatings demonstration as part of the Acoustic Superiority demonstrator (South Dakota Insertion Program - SSN 790). +$5.8M in the Request for Additional Appropriation to fund a Joint Emergent Operational Need Statement (JEONS) through the development and rapid prototyping of the Clandestine Delivered Mine (CDM).
FY 2018:  Increase in the Strategic R&D infrastructure due to obsolescence and tracking range upgrades for LSV-2.  This includes installation of new steering and diving prototype funded by FY16 congressional add.  Decrease in long-range R&D is due to completion of procurement of long-lead materials (hull treatment) for the SSN-790 demonstration.
FY 2019:  Increase in Strategic R&D infrastructure due to obsolescence and tracking range upgrades for LSV-2 at ARD Bayview.  Conduct design and approval process for replacement Inverter and Converter modules, procure materials and construct prototype units, test units, and revise design as necessary to prepare for full-ship-set production.

The FY 2019 funding request was reduced by $2.100 million to account for the availability of prior year execution balances.

| **Exhibit R-2**, **RDT&E Budget Item Justification:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **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 0603561N *I Advanced Submarine System Development* | |

Project 2096:

FY 2017:  Decrease of $4.592 for Payload Handling System (PHS) excess growth. New start program in FY17.
FY 2018 to FY 2019: PHS program growth from FY18 to FY19 is required for Long Lead Time Material (LLTM) procurement in order to maintain schedule for installation and testing onboard an SSGN. Additional program growth includes component prototype development and testing, and design and engineering team support.
FY 2019:  Increase of $3.498 for Submarine Payload Handling System (PHS).

Project 3391:

Established in FY18.  SSN/SSGN Survivability Program (S3P) previously funded under Project 2033 through FY17.

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | | | | | | | | | Date: February 2018 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Appropriation/Budget Activity** 1319 *I* 4 | | | | **R-1 Program Element (Number/Name)** PE 0603561N *I Advanced Submarine System Development* | | | | | | **Project (Number/Name)** 0223 *I Sub Combat System Improvement (ADV)* | |

| COST ($ in Millions) | Prior Years | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total | FY 2020 | FY 2021 | FY 2022 | FY 2023 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0223: *Sub Combat System Improvement (ADV)* | 485.968 | 40.626 | 40.828 | 47.118 | - | 47.118 | 49.531 | 51.708 | 51.954 | 53.053 | Continuing | Continuing |
| Quantity of RDT&E Articles | | - | - | - | - | - | - | - | - | - | | |

## A. Mission Description and Budget Item Justification

The Submarine Combat System Improvement (Advanced) (Non-ACAT) Project addresses technology challenges to improve tactical control in littoral and open ocean environments for a variety of operational missions including peacetime engagement, surveillance, battle space preparation, deterrence, regional sea denial, precision strike, task group support, and ground warfare support. These technologies, developed by Navy technology bases, the private sector, ONR, FNC, and DARPA are then transitioned. Prototype hardware/software systems are developed to demonstrate technologically promising system concepts in laboratory and at-sea submarine environments. The Advanced Sensor development program develops and tests new sensors and demonstrates large array configurations. Current efforts are directed at Towed Array sensor technologies, telemetry, and architecture, to improve reliability and performance while decreasing program life cycle costs. For large array configurations, Conformal Acoustic Velocity Sonar (CAVES), Wide Aperture Array (WAA), Large Vertical Aperture (LVA) and Large Flank Array (LFA) technologies are also being pursued. The focus of sensor processing technology efforts through the APB program will address improvements in imaging, tactical control, Electronic Warfare (EW) and acoustics, including detection, localization, classification, ranging, tracking, situational awareness, tactical decision aides, command decision support tools and displays and other functions essential to mission success. APB will also begin to develop capabilities related to Unmanned Aerial and Undersea Vehicles and automated technologies specific to CRIKT.

Technologies and/or capabilities developed under this Project will be shared, as applicable to reduce costs and optimize reuse, with development programs for surface ship sonar, Advanced Capability Build (ACB) and surveillance platforms, Advanced Surveillance Build (ASB). All three programs (ACB, ASB and APB) are managed under a common development process titled AxB. While each platform retains its uniqueness and focus in functional domains essential to mission success, a premium is placed on development of common capabilities and modular architecture technologies to maximize commonality and cost effectiveness.

This Project will participate in, and take advantage of, the Tactical Advancements for the Next Generation (TANG) initiative that utilizes Commercial Industrial Design Thinking methodologies to engage the Fleet in generating innovative improvement concepts for Submarine, Surface and Surveillance systems.

The FY 2019 funding request was reduced by $2.0 million to account for the availability of prior year execution balances.

## B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)

| | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| *Title:* Advanced Processing Build (APB) | 35.151 | 35.053 | 41.993 | 0.000 | 41.993 |
| Articles: | - | - | - | - | - |
| *Description:* APB is a four Step process: | | | | | |

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|---|---|---|
| **Exhibit R-2A**, **RDT&E Project Justification:** PB 2019 Navy | | **Date:** February 2018 |
| **Appropriation/Budget Activity** 1319 *I* 4 | **R-1 Program Element (Number/Name)** PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)** 0223 *I Sub Combat System Improvement (ADV)* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| Step 1 - algorithm/technology assessment by peer review panels of Subject Matter Experts (SME) to down-select technologies and assist developers with technical guidance. Step 2 - algorithm/technology testing with open and closed data sets to further down-select and refine capabilities prior to integration and testing. Step 3 - land-based system-level testing stimulated by the Submarine Multi-Mission Team Trainer (SMMTT), in a realistic tactical environment. Step 4 - at-sea testing on an operational submarine.<br><br>APB requirements are generated by the Submarine Tactical Requirements Group (STRG), a group of senior post command officers chaired by the Flag Officer, Director of Undersea Warfare Development Center (UWDC). Requirements are vetted by COMSUBPAC and COMSUBFOR, then provided as direction by CNO, N97.  PEO SUB provides Milestone Decision Authority (MDA) oversight and approval. Beginning in FY17, Steps 1 and 2 are conducted in a pipeline style, parallel to system integration and production. This makes Steps 1 and 2 independent of any particular Build (e.g APB-15) and allows for development of longer lead technologies. The content of a specific APB build (every two years on the odd year) will then be determined through a series of discussions with the Fleet/STRG aimed at selecting the most relevant and mature technologies available in the APB pipeline. Integration at the String and System level will then be performed followed by Steps 3 and 4, as applicable, and transition to production.<br><br>***FY 2018 Plans:***<br>- Continue the development of APB-17, complete integration for testing, conduct Step 3 land-based laboratory testing and Step 4 at-sea testing and analysis. Transition APB-17 to PEO SUB for production. Establish a Tactical Scenario Guide and conduct a Watch Section Task Analysis (WSTA) Gaps and Seams test to inform system shortfalls in the context of the selected scenarios.<br>- Collaborate with the STRG and UWDC to prepare a multi-year capability development road map to inform the content of the APB Pipeline. Initiate planning and development efforts on APB Pipeline capabilities.<br>- Continue development of a STDA common to submarine, surface, and surveillance applications.<br>- Continue EW APB development program. Analyze data collected in FY 2017. Continue systems engineering studies to determine required legacy system hardware and software architecture modernization requirements. Respond to Fleet requirements for APB-19 capabilities. Initiate selection of candidate capabilities from APB conveyor that meet Fleet requirements and commence development of gap capabilities not resident on the | | | | | |

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Navy

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| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | Date: February 2018 | | |
|---|---|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>0223 *I Sub Combat System Improvement (ADV)* | | |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| conveyor. Conduct Step 1 and Step 2 testing and initiate the APB-19 systems engineering build design process. Focus of APB-19 is expected to be EW and ASW against advanced threats.<br><br>*FY 2019 Base Plans:*<br>- Continue advanced concepts, data collection and analysis for EW APB. Anticipate integrating and testing advanced capabilities into the Next Generation EW Architecture provided by PEO SUBS.<br>- Establish EW APB land-based development environment. Expect to design and procure signal processors, tuners, high speed data recorders, and advanced simulation and stimulation equipment. The development environment should be able to simulate or ingest real world radar data.<br>- Initiate industry participation in EW development. Accept industry innovations for testing at land-based facilities.<br>- Initiate integration of successful capabilities into APB-21 baseline.<br>- Develop improved EW direction finding, environmental assessment, and detection algorithms. Initiate studies and capability development for electronic attack.<br>- Continue development of a STDA common to submarine, surface, and surveillance applications. Begin to export basic development products to Surface and Surveillance programs.<br>- Initiate studies on the use of Machine Learning, AI, and Big Data Analytics. Seek system performance improvements and 3rd Offset (automation) capabilities not currently achievable with legacy technology.<br>- Initiate development of automated technologies specific to CRIKT, targeting particular vulnerabilities.<br>- Integrate APB-19 capabilities and initiate Step-3 land based testing.<br>- Continue Step 1 and Step 2 development and testing of concepts, algorithms, and technologies in response to Fleet requirements consistent with the multi-year capability development road map developed in FY 2018.<br><br>*FY 2019 OCO Plans:*<br>N/A<br><br>*FY 2018 to FY 2019 Increase/Decrease Statement:*<br>The FY 2019 increase is driven by the requirement to significantly expand APB advanced development efforts. Advancing capabilities of adversary navies require the application of emerging state-of-the-art computing technologies and development of capabilities in non-traditional tactical areas to compliment the core APB domain. The APB development budget, which began with a limited portfolio developing Towed Array Signal Processing improvements, has since expanded over time, and is required to address Hull Arrays, Tactical Control, Tactical Decision Aids, Active Intercept & Receive, Imaging, Operator Interface Modernization, Command Tool Development, and more recently EW. The APB budget increase in FY 2019 is needed to properly resource its breadth of requirements. The increase in APB is provided to establish a needed land- | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | | Date: February 2018 | |
|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319 I 4 | | R-1 Program Element (Number/Name)<br>PE 0603561N I Advanced Submarine<br>System Development | Project (Number/Name)<br>0223 I Sub Combat System Improvement<br>(ADV) | |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| based EW capability development laboratory system; conduct new EW algorithm development; pursue the use of Big Data Analytics; Machine Learning and Artificial Intelligence (AI) computing techniques; develop new automation tools and processing for Unmanned Vehicles; and develop automated tools related to CRIKT. APB development added EW to its portfolio in FY 2017 and initial efforts included establishing a systems engineering approach, hiring national-level Subject Matter Experts (SMEs), and collecting data that will be used to initiate new capability development. Efforts in FY 2019 will build on this foundation with further data collections, system refinements, new capability development, and transition to operational use. The ability of our Submarines to operate covertly in forward areas is challenged by the emergence and wide spread use of modern commercial and military radars that exploit software-defined radio technology and can alter their operating characteristics on-the-fly with the use of a thumb drive. These radars and their waveforms are evolving quickly and are expected to continue to present a rapidly moving target for U.S. EW capabilities to keep pace with. A robust APB EW program is needed to enable our Submarines to continue to operate safely and effectively into the future. The use of modern computing technologies and new automation techniques are required to outpace emerging threat platforms that are rapidly becoming more difficult to detect. | | | | | |
| *Title:* Flank Array Demonstration | 1.675 | 1.975 | 1.325 | 0.000 | 1.325 |
| *Articles:* | - | - | - | - | - |
| *FY 2018 Plans:*<br>- Continue development of beamforming and signal processing improvements to maximize LFA capability as well as tactical/combat system updates making use of improved capabilities to perform target localization.<br>- Conduct two critical at-sea testing events for LVA2 (installed on USS Maryland) and analyze FY 2016/FY 2017 at-sea test results. This testing/analysis is necessary to integrate enhanced signal processing capability for LVAs and to collect data that will be used to improve LVA tactical performance. These processing upgrades are directly applicable to improving the forward and back-fit LVA production programs for Virginia Class Submarines, SSBN's, and Ohio Replacement Submarines. The planned increase supports critical at-sea testing events and the analysis of FY 2016/FY 2017 at-sea test results.<br><br>*FY 2019 Base Plans:*<br>- Continue to conduct critical at-sea testing events for LVA2 and analyze FY 2017/FY 2018 at-sea test results. This testing/analysis is necessary to integrate enhanced signal processing capability for LFAs and collect data that will be used to improve LVA tactical performance. These processing upgrades are directly applicable to | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | Date: February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>0223 *I Sub Combat System Improvement (ADV)* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| improving the forward and backfit LVA production programs for Virginia Class Submarines, SSBN's, and Ohio Replacement Submarines.<br><br>***FY 2019 OCO Plans:***<br>N/A<br><br>***FY 2018 to FY 2019 Increase/Decrease Statement:***<br>The FY 2019 decrease is as originally planned and is based on the focus shift from at-sea testing in FY 2018 to predominantly test result analysis in FY 2019. | | | | | |
| ***Title:*** Advanced Sensors | 3.800 | 3.800 | 3.800 | 0.000 | 3.800 |
| *Articles:* | - | - | - | - | - |
| ***FY 2018 Plans:***<br>- Continue embedded sensor and OAT component development.<br>- Complete second generation OAT component development and design and fabricate towed array modules using OAT to demonstrate high bandwidth operation and dual sample rate capability. Develop initial draft of Interface Control Documents (ICD) for OAT components.<br>- Incorporate lessons learned from FY 2017 Lake Pend Oreille (LPO) testing into FY 2018 array module designs. Update telemetry system layout, architecture, and component designs. Conduct array environmental, calibration, and LPO tow testing of FY 2018 array modules.<br>- Continue development of active and passive sensor concepts to support performance requirements for BCA. Begin preliminary test panel design and procure materials in support of FY 2018 testing.<br><br>***FY 2019 Base Plans:***<br>- Incorporate lessons learned from FY 2018 LPO testing into FY 2019 array module design. Complete OAT component development, system architecture, and associated ICDs. Conduct array environmental, calibration, and LPO testing of FY 2019 array modules.<br>- Begin procurement and fabrication of full length OAT array Advance Development Model (ADM).<br>- Continue development of the High Speed Signal Path (HSSP).<br>- Continue development of active and passive sensor concepts to support performance requirements for BCA. Begin test panel design and procure materials in support of FY 2019 testing.<br><br>***FY 2019 OCO Plans:***<br>N/A<br><br>***FY 2018 to FY 2019 Increase/Decrease Statement:*** | | | | | |

| **Exhibit R-2A**, **RDT&E Project Justification:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>0223 *I Sub Combat System Improvement (ADV)* |

| **B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)** | **FY 2017** | **FY 2018** | **FY 2019 Base** | **FY 2019 OCO** | **FY 2019 Total** |
|---|---|---|---|---|---|
| No significant change in FY18 to FY19 requested funding in accordance with program's plan. | | | | | |
| **Accomplishments/Planned Programs Subtotals** | 40.626 | 40.828 | 47.118 | 0.000 | 47.118 |

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

 N/A

**Remarks**

**D. Acquisition Strategy**

 Use competitively awarded contracts from Broad BAA solicitations and SBIR initiatives. Integration to fielded systems performed under contracts awarded by the recipient production program within PEO SUB.

**E. Performance Metrics**

 - APB: Deliver at-sea tested submarine capability improvements to PEO SUB as prescribed by the Fleet every two years. Conduct milestone reviews with the Milestone Decision Authority (MDA), PEO SUB prior to delivery.
 - Deliver Next Generation TB-29(x) optimum sensor evaluation report.
 - Deliver Fat Line Vector Sensor Towed Array (VSTA) Lake Pend Oreille test reports.

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2019 Navy | | | | | | | | | | | | | Date: February 2018 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Appropriation/Budget Activity<br>1319 I 4 | | | R-1 Program Element (Number/Name)<br>PE 0603561N I Advanced Submarine System Development | | | | | | | | Project (Number/Name)<br>0223 I Sub Combat System Improvement (ADV) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

### Product Development ($ in Millions)

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 | | FY 2018 | | FY 2019 Base | | FY 2019 OCO | | FY 2019 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | | | |
| Product Development | C/CPFF | Adaptive Methods : VA | 1.425 | 0.250 | Dec 2016 | 0.250 | Jan 2018 | 0.300 | Dec 2018 | - | | 0.300 | 0.000 | 2.225 | Continuing |
| Product Development | C/CPFF | Alion Sciences : VA | 3.267 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 3.267 | Continuing |
| Product Development | C/CPFF | Arete : CA | 0.550 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 0.550 | - |
| Product Development | C/CPFF | Chesapeake Science (L-3) : MD | 7.551 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 7.551 | Continuing |
| Product Development | C/CPFF | Electric Boat : ME | 1.785 | 0.070 | Jul 2017 | 0.070 | Mar 2018 | 0.070 | Dec 2018 | - | | 0.070 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | General Dynamics : VA | 22.031 | 2.000 | Dec 2016 | 2.500 | Feb 2018 | 3.030 | Dec 2018 | - | | 3.030 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | GA Tech Research Institute : GA | 3.076 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 3.076 | Continuing |
| Product Development | C/CPFF | In Depth Engineering : VA | 5.365 | 0.970 | Nov 2016 | 0.500 | Dec 2017 | 0.990 | Dec 2018 | - | | 0.990 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | JHU/APL : MD | 93.355 | 8.541 | Nov 2016 | 9.400 | Nov 2017 | 9.884 | Dec 2018 | - | | 9.884 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | Lockheed Martin : VA | 63.478 | 7.812 | Nov 2016 | 8.535 | Nov 2017 | 8.998 | Dec 2018 | - | | 8.998 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | Lockheed Martin : NY | 9.564 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 9.564 | Continuing |
| Product Development | C/CPFF | Metron : VA | 7.253 | 0.900 | Nov 2016 | 1.000 | Nov 2017 | 1.595 | Dec 2018 | - | | 1.595 | Continuing | Continuing | Continuing |
| Product Development | WR | NSWC/Carderock : MD | 27.299 | 2.535 | Oct 2016 | 2.585 | Oct 2017 | 2.720 | Nov 2018 | - | | 2.720 | Continuing | Continuing | Continuing |
| Product Development | WR | NUWC/Newport : RI | 94.245 | 6.868 | Nov 2016 | 6.480 | Oct 2017 | 7.670 | Nov 2018 | - | | 7.670 | Continuing | Continuing | Continuing |
| Product Development | C/CPAF | NSMA : VA | 11.894 | 0.550 | Feb 2017 | 0.650 | Apr 2018 | 0.000 | | - | | 0.000 | Continuing | Continuing | Continuing |
| Product Development | WR | ONI : DC | 2.295 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 2.295 | Continuing |
| Product Development | WR | ONR : VA | 2.725 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 2.725 | Continuing |
| Product Development | C/CPFF | Progeny : VA | 7.739 | 0.535 | Nov 2016 | 0.650 | Feb 2018 | 0.640 | Feb 2019 | - | | 0.640 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | PSU/ARL : PA | 9.480 | 0.850 | Nov 2016 | 0.650 | Dec 2017 | 0.650 | Dec 2018 | - | | 0.650 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | SAIC : VA | 3.555 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 3.555 | Continuing |
| Product Development | C/CPFF | Sedna Digital : VA | 12.264 | 1.600 | Feb 2017 | 1.650 | Dec 2017 | 1.830 | Dec 2018 | - | | 1.830 | Continuing | Continuing | Continuing |
| Product Development | WR | SSC/San Diego : CA | 1.963 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 1.963 | Continuing |

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / Advanced Submarine System Development | **Project (Number/Name)**<br>0223 / Sub Combat System Improvement (ADV) |

### Product Development ($ in Millions)

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 Cost | FY 2017 Award Date | FY 2018 Cost | FY 2018 Award Date | FY 2019 Base Cost | FY 2019 Base Award Date | FY 2019 OCO Cost | FY 2019 OCO Award Date | FY 2019 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Product Development | MIPR | U.S. Army Research Lab : MD | 1.700 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 1.700 | Continuing |
| Product Development | MIPR | U.S. Army/MITRE : NJ | 4.595 | 0.000 | | 1.408 | Dec 2017 | 1.435 | Dec 2018 | - | | 1.435 | Continuing | Continuing | Continuing |
| Product Development | MIPR | U.S. Hanscom AFB/ MIT Lincoln Labs : MA | 17.289 | 2.080 | Dec 2016 | 2.150 | Dec 2017 | 2.525 | Dec 2018 | - | | 2.525 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | UT/ARL : TX | 28.809 | 0.775 | Nov 2016 | 0.700 | Dec 2017 | 0.800 | Dec 2018 | - | | 0.800 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | VAR : VAR* | 22.723 | 3.232 | Dec 2016 | 0.592 | Dec 2017 | 3.069 | Dec 2018 | - | | 3.069 | Continuing | Continuing | Continuing |
| | | **Subtotal** | 467.275 | 39.568 | | 39.770 | | 46.206 | | - | | 46.206 | Continuing | Continuing | N/A |

**Remarks**
 *Consists of multiple performing activities with funding for each not greater than $1M per year.

### Support ($ in Millions)

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 Cost | FY 2017 Award Date | FY 2018 Cost | FY 2018 Award Date | FY 2019 Base Cost | FY 2019 Base Award Date | FY 2019 OCO Cost | FY 2019 OCO Award Date | FY 2019 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Need Item Text | C/BA | Not Specified : Not Specified | 0.000 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 0.000 | - |
| | | **Subtotal** | 0.000 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 0.000 | N/A |

### Management Services ($ in Millions)

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 Cost | FY 2017 Award Date | FY 2018 Cost | FY 2018 Award Date | FY 2019 Base Cost | FY 2019 Base Award Date | FY 2019 OCO Cost | FY 2019 OCO Award Date | FY 2019 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Program Management Support | C/CPAF | BAE Systems : MD | 12.665 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 12.665 | Continuing |
| Program Management Support | C/CPIF | CGI Federal : VA | 1.000 | 1.000 | May 2017 | 1.000 | Feb 2018 | 0.854 | Dec 2018 | - | | 0.854 | Continuing | Continuing | Continuing |

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2019 Navy | | | | | | | | | | | | Date: February 2018 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Appropriation/Budget Activity<br>1319 *I* 4 | | | R-1 Program Element (Number/Name)<br>PE 0603561N *I Advanced Submarine System Development* | | | | | Project (Number/Name)<br>0223 *I Sub Combat System Improvement (ADV)* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Management Services ($ in Millions) | | | | FY 2017 | | FY 2018 | | FY 2019 Base | | FY 2019 OCO | | FY 2019 Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Cost To Complete | Total Cost | Target Value of Contract |
| Program Management Support | C/CPFF | EG&G (URS) : VA | 4.291 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 4.291 | Continuing |
| Travel | Allot | NAVSEA PEO IWS5 : DC | 0.737 | 0.058 | Dec 2016 | 0.058 | Jan 2018 | 0.058 | Oct 2018 | - | | 0.058 | Continuing | Continuing | Continuing |
| | | Subtotal | 18.693 | 1.058 | | 1.058 | | 0.912 | | - | | 0.912 | Continuing | Continuing | N/A |

| | | | Prior Years | FY 2017 | | FY 2018 | | FY 2019 Base | | FY 2019 OCO | | FY 2019 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Project Cost Totals | 485.968 | 40.626 | | 40.828 | | 47.118 | | - | | 47.118 | Continuing | Continuing | N/A |

**Remarks**

**Exhibit R-4**, RDT&E Schedule Profile: PB 2019 Navy | **Date:** February 2018

| **Appropriation/Budget Activity** 1319 *I* 4 | **R-1 Program Element (Number/Name)** PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)** 0223 *I Sub Combat System Improvement (ADV)* |
|---|---|---|

| Project 0223 | FY 2017 | | | | FY 2018 | | | | FY 2019 | | | | FY 2020 | | | | FY 2021 | | | | FY 2022 | | | | FY 2023 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |

Advanced Processing Build (APB) Development Pipeline — APB Development Pipeline (FY2017 Q1 – FY2023 Q4)

Advanced Processing Build (APB-17) — ▲ At-Sea Test (FY2018 Q3); ■ APB-17 Transition (FY2018 Q4)

Advanced Processing Build (APB-19) — ▲ At-Sea Test (FY2020 Q3); ■ APB-19 Transition (FY2020 Q4)

Advanced Processing Build (APB-21) — ▲ At-Sea Test (FY2022 Q3); ■ APB-21 Transition (FY2022 Q4)

Flank Array Demonstration — Beamforming Development (FY2017 Q1 – FY2017 Q4); Test Planning (FY2017 Q1 – FY2018 Q4); Test Events (FY2017 Q1 – FY2019 Q1); Test Analysis (FY2017 Q1 – FY2020 Q2)

Advanced Sensors — Develop Array Technologies (FY2017 Q1 – FY2023 Q3); Build / Test Proto (FY2017 Q1 – FY2023 Q3); Bow Conformal Assessments / Concept Designs (FY2017 Q1 – FY2021 Q4)

| **Exhibit R-4A**, **RDT&E Schedule Details:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>0223 *I Sub Combat System Improvement (ADV)* |

## Schedule Details

| Events by Sub Project | Start | | End | |
|---|---|---|---|---|
| | **Quarter** | **Year** | **Quarter** | **Year** |
| ***Proj 0223*** | | | | |
| Advanced Processing Build (APB): APB Development | 1 | 2017 | 4 | 2023 |
| Advanced Processing Build (APB): APB-17: APB-17 At-Sea Test | 3 | 2018 | 3 | 2018 |
| Advanced Processing Build (APB): APB-17: Transition APB-17 to PEO SUB Production Programs | 4 | 2018 | 4 | 2018 |
| Advanced Processing Build (APB): APB-19: APB-19 At-Sea Test | 3 | 2020 | 3 | 2020 |
| Advanced Processing Build (APB): APB-19: Transition APB-19 to PEO SUB Production Programs | 4 | 2020 | 4 | 2020 |
| Advanced Processing Build (APB): APB-21: APB-21 At-Sea Test | 3 | 2022 | 3 | 2022 |
| Advanced Processing Build (APB): APB-21: Transition APB-21 to PEO SUB Production Programs | 4 | 2022 | 4 | 2022 |
| Flank Array: Beamforming Development | 1 | 2017 | 4 | 2017 |
| Flank Array: Flank Array Test Planning | 1 | 2017 | 1 | 2019 |
| Flank Array: Flank Array Test Conduct | 4 | 2017 | 4 | 2019 |
| Flank Array: Flank Array Test Analysis | 1 | 2017 | 4 | 2020 |
| Advanced Sensors: Develop Array Technologies | 1 | 2017 | 4 | 2023 |
| Advanced Sensors: Build & Test Prototype Arrays | 1 | 2017 | 4 | 2023 |
| Advanced Sensors: Bow Conformal Assessments / Concept Designs | 1 | 2017 | 4 | 2021 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Exhibit R-2A**, **RDT&E Project Justification:** PB 2019 Navy | | | | | | | | | | **Date:** February 2018 | | |
| **Appropriation/Budget Activity**<br>1319 *I* 4 | | | | | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | | | | | **Project (Number/Name)**<br>2033 *I Adv Submarine Systems Development* | | |

| COST ($ in Millions) | Prior Years | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total | FY 2020 | FY 2021 | FY 2022 | FY 2023 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2033: *Adv Submarine Systems Development* | 447.467 | 51.684 | 35.795 | 30.685 | - | 30.685 | 32.589 | 34.917 | 34.923 | 35.774 | Continuing | Continuing |
| Quantity of RDT&E Articles | | - | - | - | - | - | - | - | - | - | | |

### A. Mission Description and Budget Item Justification

The Advanced Submarine Systems Development (ASSD) Program is a non-acquisition program that develops and matures advanced technologies for successful integration into current and future submarine classes and in so doing lowers the technical and cost risks of integrating these new technologies prior to acquisition and speeds their delivery as capabilities into the Fleet and into formal Programs Of Record (PORs). ASSD transitions Hull, Mechanical, and Electrical (HM&E) technologies, payloads, and future naval concepts from the Science & Technology (S&T) and Research and Development (R&D) communities through the development, maturation, and technical integration of technology projects to operational submarine platforms for assessment, testing, and evaluation. Once the projects have proven their maturity and promise through at-sea testing they are formally transitioned into formal programs of record at lower risk and costs. Additionally, ASSD operates and maintains R&D infrastructure assets that are critical in the long-term design, assessment and construction of modern, stealthy submarine platforms.

The program works with Small Business Innovation Research (SBIR), Small Business Technology Transfer (STTR), Office of Secretary of Defense (OSD), Office of Naval Research (ONR), and Defense Advanced Research Projects Agency (DARPA) organizations to transition technology for integration into current and future submarine classes to achieve new transformational capabilities while achieving total-ownership cost reductions. Experimentation and demonstration are conducted in a joint warfighting context with other services, (i.e. the U.S. Marines, U.S. Army, and the U.S. Air Force), to enable early assessment of the new technology's warfighting capabilities, and to inform the fleet and acquisition community on smarter technology-selection decisions. This program also supports cooperative R&D through Information/Data Exchange Agreements (IEA/ DEA) and joint Project Arrangements (PA) with the United Kingdom, Australia and other international partners. These international cooperative activities achieve future submarine class total ownership cost reductions, and influence future submarine concept designs and core technologies. Overall, the technology efforts in ASSD develop future technologies that are to be integrated into the Virginia class, Columbia class, future submarines and in-service submarine programs.

Several programmatic budget changes are notable in this year's budget exhibits. (1) SEA073 has established new programmatic pillars to better align the different projects within Project 2033 (Strategic Capability R&D Infrastructure, Long Range R&D Investment, and Rapid Technology Development and Ship Integration). The specific project efforts within these new pillars have not changed other than new program starts and completions that are detailed below. (2) The SSN/SSGN Survivability Program (S3P) efforts previously funded under this project (through FY17) were moved to Project 3391 in FY18. The S3P program addresses gaps in stealth and the survivability for the current and future SSN/SSGN force. (3) The increase in funding from FY 2017 to FY 2018 in the Strategic Capability R&D Infrastructure pillar supports critical obsolescence upgrades to the Large Scale Vehicle (LSV-2) to enable its continued operation in support of the Columbia class propulsor test program and future submarine stealth improvements. These investments continue in FY19, (4) The decrease in funding in Long Range R&D is a result of the completion of material procurements and the surge in non-recurring engineering efforts to support installation of the advanced hull treatment advanced demonstrator effort as part of the Acoustic Superiority project on the USS South Dakota (SSN 790) starting in FY18. Future SEA073 investment in advanced hull treatments shifts to the transition of the materials developed as part of ONR's Future Naval Capability (FNC) program that will culminate in another at-sea demonstration in the FY21-22

| **Exhibit R-2A**, **RDT&E Project Justification:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 **/** 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N **/** *Advanced Submarine System Development* | **Project (Number/Name)**<br>2033 **/** *Adv Submarine Systems Development* |

timeframe.  (5) Increase in FY17 Rapid Development due to OSD Supplemental Add for the Mining Expendable Delivery Unmanned Submarine Asset (MEDUSA formally named CDM/Bull Shark); next phase of project execution to complete design, fabricate system, and demonstrate on a 688 class submarine in FY20 has transitioned to Unmanned Maritime Systems program office (PMS406) as of Q4 FY17.  Additional funding to cover efforts in FY18-20 are covered under PMS406 AUP/ AUWP funding lines.

Project 2033 is comprised of three programmatic budget categories: Strategic Capability R&D Infrastructure, Long Range R&D Investment, and Rapid Technology Development and Ship Integration.  Strategic capability R&D infrastructure is investment to maintain and operate critical, one-of-a-kind submarine R&D assets that enable the design and manufacture of the stealthiest submarines in the world without the requirement to develop and test at full scale which is inordinately expensive and risky. Long-range R&D investment is the maturation and prototyping at full-scale of long- range (5-10 years) technologies to enable their maturation and readiness for incorporation into existing and future submarine baselines.  The objective is to achieve high technology readiness (TRL-7) of the targeted technology so that it can be incorporated into the baseline submarine design during the detailed design contract award. Rapid technology development and ship integration projects are efforts designed to mature higher TRL capabilities and field the particular technology project capability within an 18-30 month window from program start to submarine at-sea demonstration. All projects are determined by senior USW leadership and N97 sponsor direction.

SEA073 additionally initiates seedling technology projects (<$800K/year) under the innovative technology transition effort to assess new technology candidates and keep the submarine/USW technology pipeline primed. This effort is executed in the Long-Range R&D investment pillar.

Major technology developmental efforts include:
Strategic Capability R&D Infrastructure
-       Large Scale Vehicle (LSV)
-       Intermediate Scale Measurement System (ISMS)
Long Range R&D
-       Advanced Submarine Hull Coatings
-       Advanced Signature Management
-       Advanced Submarine Control/Stationkeeping
-       Advanced Material Propeller/Next Generation Thrust (Future Propulsor/Shaft Technologies)
- Submarine Corrosion Control Technologies
Rapid Technology Development and Submarine Integration
- Common Unmanned Aerial Vehicle (UAS) Communications
- Fleet Modular Autonomous Undersea Vehicle (FMAUV)
- Li-Ion Battery for FMAUV Submarine Integration
-       Mining Expendable Devlivery Unmanned Submarine Asset (MEDUSA).  Project transitioned to Unmanned Maritime Systems program office via MOU for execution of Phase II
- Long-Range Deployable/Retrievable Instrumented Intelligence, Surveillance and Reconnaissance (ISR) Buoy

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | Date: February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / *Advanced Submarine System Development* | **Project (Number/Name)**<br>2033 / *Adv Submarine Systems Development* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| *Title:* Strategic Capability R&D Infrastructure | 14.825 | 18.046 | 18.046 | 0.000 | 18.046 |
| *Articles:* | - | - | - | - | - |

*Description:* Sustains Navy R&D capability for continued operations of the Large Scale Vehicle (LSV-2) and the Intermediate Scale Measurement System (ISMS) test facility in support of VIRGINIA and COLUMBIA Class Programs (plus numerous other smaller programs) and future submarine technology development.  Critical submarine stealth enabler.  Facilities support the
conduct of large scale model experiments for submarines.  Facilities focus on evaluating the stealth, control, affordability, and operational effectiveness of new technologies that are prototyped on large-scale models.  The technology validation provided by the models has provided significantly cost and schedule savings by allowing prototyping and development at just under full-scale vice with first-of-hull assets.

*FY 2018 Plans:*
Continue ongoing system upgrades and replacements per scheduled for ISMS. Execute LSV2 core ship systems maintenance, maintain crew qualification, ensure compliance with all LSVSAFE and general regulations. Complete guidance and navigation system upgrade. Upgrade acoustic array assets to support future testing; maintain and operate acoustic data systems and all required shore support systems, ensure calibration and setup of new tracking and control system. Begin build of steering and diving replacement unit.  Continue critical COLUMBIA propulsor trials. Execute LSV2 alterations to support COLUMBIA signature and propulsor trials vehicle including tracking range.  Execute requirements phase for LSV2 drive system replacement.

*FY 2019 Base Plans:*
Conduct LSV2 core ship systems maintenance, maintain crew qualification, ensure compliance with all LSVSAFE and general regulations, maintain and operate acoustic data systems and all required shore support systems. Operate and maintain ISMS acoustic test range underwater and shore-based facilities. Continue ongoing system upgrades and replacement on ISMS. Continue critical COLUMBIA propulsor trials, support advanced array hardware and systems maintenance. Support ship and system alterations to safely support COLUMBIA signature and propulsor trials.  Install replacement of replacement steering and diving actuator system into LSV2.

*FY 2019 OCO Plans:*
N/A

| *Title:* Long Range R&D | 25.863 | 11.399 | 8.282 | 0.000 | 8.282 |
|---|---|---|---|---|---|
| *Articles:* | - | - | - | - | - |

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | Date: February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>2033 *I Adv Submarine Systems Development* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|

*Description:* Develop advanced technologies and tools to increase current and future submarine capabilities, lower acquisition and life-cycle costs, and enhance the survivability of submarines.  Develop technologies and Tactics, Techniques, and Procedures (TTPs) that facilitates new and enhance existing warfighting concepts. The program currently supports development of advanced submarine hull coatings for improved acoustic performance, maintainability, and cost with the objective of near-term implementation on VIRGINIA and COLUMBIA class platforms as well as future submarine classes. The budget line continues to develop technologies for submarine alternative propulsion and propulsor designs to enhance submarine maneuverability and stealth, and stern configurations with potential to significantly reduce submarine acquisition costs while increasing performance.  Lastly, this long-range R&D continues to develop and demonstrate technologies for future submarines in areas of hull and platform technologies, propulsors, propellers, corrosion control, ship control, electric actuation, sensors, and self-defense systems that are providing near- term capability and cost reduction for in-service and future submarine classes.

*FY 2018 Plans:*
Complete corrosion FNC at-sea TEMPALT testing and baseline technologies in the Columbia, VA Block IV or V Classes.  Conduct motor dynamometer testing, and in-water operational pressure testing of the ASC PPM 82 pump jet technology and initiate transition and shipboard integration efforts to introduce the technology as VA Block VI capability.    Initiate planning and design for an Advanced Control Effectors technology prototype for land based testing demonstrator on 668 class submarine. Complete fatigue testing of the Advanced Material Propeller (AMP) Generation 2 full scale metallic hub and three composite blades in Australia.  Complete the manufacture and testing of Generation 3 full-scale AMP metallic hub and all composite blades and ship to AUS in preparation for at-sea Collins class testing.  Finalize trial plan priorities and obtain approval from US and AUS authorities that propeller is acceptable for trial.  Continue to leverage products from Small Business and Independent Research and Development (IR&D) efforts. Execute advanced signature management trials on a submarine platform and conduct analysis to inform initial system requirements and capabilities. Assess and study new technologies for future submarines and perform studies to improve platform capability and performance in support of the Tactical Submarine Evolution Plan (TSEP).

Identify enabling technologies and submarine concept design integration characteristics. Initiate technology development efforts on critical, long-lead technologies.  Continue to define and evaluate new/alternative Next Generation Thrust (NGT) technologies, design concepts, alternative materials and evaluate system configuration arrangements and initiate next gen propulsor technology project (classified details) for insertion in VA Block VII.

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | | | Date: February 2018 | |
|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 4 | | R-1 Program Element (Number/Name)<br>PE 0603561N / *Advanced Submarine System Development* | | Project (Number/Name)<br>2033 / *Adv Submarine Systems Development* | |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| Start second US-UK Electromagnetics project arrangement with laboratory stress magnetization and electric model experiments on joint US/UK models and commencement of detailed planning for large-scale testing to perform underwater electric and magnetic signature testing utilizing US and UK asset(s) at a US range facility. Deliver materials and TDPs to support installation of new hull treatment on SSN 790.  Initiate industrialization and large-scale testing of ONR advanced hull material candidates in cooperation with ONR MANTECH and begin initial planning for an at-sea demonstration on a VA class submarine.<br><br>*FY 2019 Base Plans:*<br>Remove ICMS, AASGS SCS and AASGS CT TEMPALTs. Complete transitions to COLUMBIA and VA Class programs.  Install and test full-scale AMP propeller on Collins-Class submarine and conduct at-sea trials.  Initiate follow-on project arrangement for destructive testing and analysis of full-scale propeller data. Continue to leverage products from Small Business and Independent Research and Development (IR&D) efforts and technology seedling efforts.  Continue NGT design studies and plan small and/or large scale testing of technologies continue technology development (classified details) for insertion into VA Block VII.   Continue industrialization and material assessment to transition advanced coatings technologies from ONR FNC effort. Final tile sizes and coverage for full scale demonstration will be defined to support FY19 OPALT package development for VA Class demonstration.  Finalize the industrialization of the ONR advanced treatment, fabrication processes, and down select to a single material candidate to finalize development of a VA Class OPALT package.  Execute US-UK submarine EM and acoustic trials at US range and conduct data analysis and begin TDP development for insertion of technology into VA Class Block VI and downstream VA trial. Initiate advanced signature management demonstrator development and begin TDP and test planning development. Complete transition of pump-jet technology to VA Class. Initiate development of the Advanced Control Effectors technology prototype for land based testing.  Assess and study future technologies for future submarines and perform studies for improved platform capability and performance in support of the Tactical Submarine Evolution Plan (TSEP).<br><br>*FY 2019 OCO Plans:*<br>N/A<br><br>*FY 2018 to FY 2019 Increase/Decrease Statement:*<br>To account for project wide underexecution and funding reduction, several Long-Range R&D pillar projects received targeted reductions in investment, to include the Advanced Hull Treatments, Advanced Signature | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | Date: February 2018 | |
|---|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>2033 *I Adv Submarine Systems Development* | |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| Management, and Advanced SSN Technology/TSEP projects. These budget cuts will be realized via near term reductions in project level of effort/scope and associated extensions of project timelines. | | | | | |
| *Title:* Rapid Technology Development and Submarine Integration<br><br>*Articles:* | 10.996<br>- | 6.350<br>- | 4.357<br>- | 0.000<br>- | 4.357<br>- |

*Description:* Conducts Navy and joint demonstrations of advanced technologies and payloads in order to assess the operational value of the technologies and systems under consideration to speed transition of operational capabilities. Focus is to develop, demonstrate, and transition technology projects in an 18 -30 month period. Transition successful, high-interest, high impact systems to the acquisition community.

*FY 2018 Plans:*
- Fabricate SAFECAP (fabrication of lithium ion vehicle kit, system level platform checkout testing, development of fully certified submarine integrated TEMPALT), achieve TEMPALT approval and plan at-sea testing of the final submarine SAFECAP hardware and TEMPALT package.
- Conduct testing of the common, communication architecture for UAS from a submarine or land-based test facility. Initiate transition to Combat Control System (PMS425), Submarine Imaging & Electronic Warfare (PMS435) program offices. Develop and provide antenna systems for operations (UAS Common Communications) to fleet. Demonstrate E2E capability at the end of FY18 or start of FY19 depending on test platform availability.
- Initiate development of long-range, deployable/retrievable instrumented ISR buoy. Initiate TEMPALT design and operational test plan development.
- Initiate development of approved Joint Concept Test Demonstration (JCTD) or Undersea Rapid Capability Initiatives (URCI)candidate project. Specific project concept will be developed through low-level demonstration testing.

*FY 2019 Base Plans:*
- Demonstrate the common communications, Unmanned Aerial System (UAS) operation if unperformed in FY18 Q4.
- Demonstrate the Lithium Ion SAFECAP FMAUV design in a capstone test. Transition the design into the LBS program of record in the Battlespace Awareness and Information's Operations Program Office (PMW 120).
- Continue development of approved Joint Concept Test Demonstration (JCTD)or URCI project. Initiate development of TDP and submarine TEMPALT for initial prototyping and demonstration.

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | Date: February 2018 |
|---|---|---|
| Appropriation/Budget Activity<br>1319 / 4 | R-1 Program Element (Number/Name)<br>PE 0603561N / Advanced Submarine<br>System Development | Project (Number/Name)<br>2033 / Adv Submarine Systems<br>Development |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| - Continue development of the long-range, deployable/retrievable instrumented ISR buoy. Complete TEMPALT development and operational test plan development. Target test of initial capability in FY20.<br><br>**FY 2019 OCO Plans:**<br>N/A<br><br>**FY 2018 to FY 2019 Increase/Decrease Statement:**<br>The Rapid Technology Development and Submarine Integration decrease was largely accounted for in the planned technology transition of the UAS COMMs project to PMS435 and the deferral of follow-on rapid prototyping efforts. While the planned transfer of UAS COMMS project to PMS435 limited impacts to other ongoing projects, the budget decrease within this pillar significantly reduced the overall scope of Project 2033 prototyping. | | | | | |
| **Accomplishments/Planned Programs Subtotals** | 51.684 | 35.795 | 30.685 | 0.000 | 30.685 |

**C. Other Program Funding Summary ($ in Millions)**
 N/A
**Remarks**

**D. Acquisition Strategy**

 Non-ACAT program with BA4 R&D investment. Projects transition via formal processes to acquisition programs of record for inclusion into existing ship baselines or initiation as new POR capabilities. Sole source Concept Formulation (CONFORM) contracts with the only two submarine design/construction shipyards, General Dynamics Electric Boat (GDEB) and Huntington Ingalls Industries (HII) facilitate this process. Use of topic-specific Broad Area Announcement (BAA) solicitations to advance submarine advanced technology work. Engagement with industry to build vendor base and support development of R&D products for enhanced submarine capability via competitively awarded Small Business
 Innovation Research (SBIR) and Broad Agency Agreement (BAA) contracts to support advanced technology Hull Mechanical & Electrical (HM&E) and payload systems.

**E. Performance Metrics**
 - Sustain critical one of a kind national Research and Development (R&D) hydroacoustic infrastructure enabling the design and assessment of VIRGINIA Class, COLUMBIA Class, and future submarine class designs.
 - Deliver 2-3 Rapid Prototype projects annually to evaluating future submarine technology/payload concepts. Execute projects in established timelines and under cost cap. Target deliverables as tactical TEMPALTs.
 - Assess as-built VIRGINIA and SSGN submarines for design drivers/design tools and model validation to define R&D needs for future submarine classes.
 - Industrialize future submarine coatings to enable continued acoustic superiority of VA Class design and field as and advanced demonstrator.
 - Successfully construct and deliver full-scale advanced material propeller for at-sea testing.

| **Exhibit R-2A**, **RDT&E Project Justification:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity** 1319 *I* 4 | **R-1 Program Element (Number/Name)** PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)** 2033 *I Adv Submarine Systems Development* |
| - Develop summary report on modeling approaches and associated predicted performance in the area of hull sensors, threat environments, and situational awareness. | | |

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2019 Navy | | | | | | | | | | | | Date: February 2018 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Appropriation/Budget Activity 1319 / 4 | | R-1 Program Element (Number/Name) PE 0603561N I Advanced Submarine System Development | | | | | | | Project (Number/Name) 2033 I Adv Submarine Systems Development | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

### Product Development ($ in Millions)

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 Cost | FY 2017 Award Date | FY 2018 Cost | FY 2018 Award Date | FY 2019 Base Cost | FY 2019 Base Award Date | FY 2019 OCO Cost | FY 2019 OCO Award Date | FY 2019 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Product Development | WR | NSWC Crane : Crane, IN | 0.000 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 0.000 | - |
| Product Development | WR | NSWC PHILLY : Philly, PA | 0.165 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | Continuing | Continuing | Continuing |
| Product Development | WR | NRL : Washington, DC | 2.318 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 2.318 | - |
| Product Development | SS/CPFF | SupShips : Groton, CT | 2.958 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 2.958 | - |
| Product Development | SS/CPFF | HII : Newport News, VA | 8.580 | 4.930 | Apr 2017 | 4.954 | Apr 2018 | 3.000 | Apr 2019 | - | | 3.000 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | EB : Groton, CT | 61.651 | 13.134 | Apr 2017 | 2.901 | Apr 2018 | 2.648 | Apr 2019 | - | | 2.648 | Continuing | Continuing | Continuing |
| Product Development | WR | NSWC : Carderock, MD | 89.213 | 5.705 | Apr 2017 | 5.750 | Apr 2018 | 5.000 | Apr 2019 | - | | 5.000 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | ARL/PSU : State College, PA | 8.428 | 0.575 | Apr 2017 | 0.580 | Apr 2018 | 0.585 | Apr 2019 | - | | 0.585 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | JHU/APL : Laurel, MD | 21.997 | 1.200 | Apr 2017 | 1.224 | Apr 2018 | 1.225 | Apr 2019 | - | | 1.225 | Continuing | Continuing | Continuing |
| Product Development | Various | Various : Various | 35.921 | 0.289 | Apr 2017 | 0.290 | Apr 2018 | 0.296 | Apr 2019 | - | | 0.296 | Continuing | Continuing | Continuing |
| Product Development | WR | NUWC : Newport, RI | 76.133 | 1.820 | Mar 2017 | 1.825 | Mar 2018 | 1.830 | Mar 2019 | - | | 1.830 | Continuing | Continuing | Continuing |
| Product Development | WR | ONR : Arlington, VA | 10.224 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | Progeny : Manassas VA | 0.695 | 0.000 | | 0.000 | | 0.000 | May 2019 | - | | 0.000 | 0.000 | 0.695 | - |
| **Subtotal** | | | 318.283 | 27.653 | | 17.524 | | 14.584 | | - | | 14.584 | Continuing | Continuing | N/A |

### Remarks

Various/VAR is used to group multiple activities with small funding levels.
Activities will be incrementally funded. The award dates reflect the latest incremental portion funds will obligate.

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2019 Navy | | | | | | | | | | | | | Date: February 2018 | | |
|---|---|

**Appropriation/Budget Activity** 1319 / 4  |  **R-1 Program Element (Number/Name)** PE 0603561N / Advanced Submarine System Development  |  **Project (Number/Name)** 2033 / Adv Submarine Systems Development

### Support ($ in Millions)

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 Cost | FY 2017 Award Date | FY 2018 Cost | FY 2018 Award Date | FY 2019 Base Cost | FY 2019 Base Award Date | FY 2019 OCO Cost | FY 2019 OCO Award Date | FY 2019 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contractor Engineering Support | SS/CPFF | Various : Various | 13.617 | 1.339 | Jun 2017 | 1.340 | Jun 2018 | 1.350 | Mar 2019 | - | | 1.350 | Continuing | Continuing | Continuing |
| Government Engineering Support | WR | Various : Various | 6.863 | 0.350 | Mar 2017 | 0.357 | Mar 2018 | 0.364 | Mar 2019 | - | | 0.364 | Continuing | Continuing | Continuing |
| Travel | WR | NAVSEA HQ : Not Specified | 1.003 | 0.100 | Mar 2017 | 0.102 | Mar 2018 | 0.104 | Mar 2019 | - | | 0.104 | Continuing | Continuing | Continuing |
| Acquisition Workforce | Various | Not Specified : Not Specified | 0.293 | 0.000 | | 0.000 | | 0.000 | Nov 2018 | - | | 0.000 | 0.000 | 0.293 | 0.293 |
| Subtotal | | | 21.776 | 1.789 | | 1.799 | | 1.818 | | - | | 1.818 | Continuing | Continuing | N/A |

**Remarks**
Various/VAR is used to group multiple activities with small funding levels.
Activities will be incrementally funded. The award dates reflect the latest incremental portion funds will obligate.

### Test and Evaluation ($ in Millions)

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 Cost | FY 2017 Award Date | FY 2018 Cost | FY 2018 Award Date | FY 2019 Base Cost | FY 2019 Base Award Date | FY 2019 OCO Cost | FY 2019 OCO Award Date | FY 2019 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Developmental Test & Evaluation | SS/CPFF | EB : Groton, CT | 13.698 | 5.800 | May 2017 | 5.810 | May 2018 | 5.820 | May 2019 | - | | 5.820 | Continuing | Continuing | Continuing |
| Developmental Test & Evaluation | WR | NSWC/PHILLY : PHILLY, PA | 9.104 | 0.000 | | 0.000 | | 0.000 | Oct 2018 | - | | 0.000 | 0.000 | 9.104 | 9.104 |
| Developmental Test & Evaluation | Various | Various : Various | 7.387 | 0.670 | Apr 2017 | 0.675 | Apr 2018 | 0.675 | Apr 2019 | - | | 0.675 | 0.000 | 9.407 | 6.372 |
| Developmental Test & Evaluation | WR | NUWC : Newport, RI | 22.883 | 7.027 | Apr 2017 | 1.255 | Apr 2018 | 1.050 | Apr 2019 | - | | 1.050 | Continuing | Continuing | Continuing |
| Developmental Test & Evaluation | WR | NSWC : Carderock, MD | 43.892 | 6.745 | Apr 2017 | 6.732 | Apr 2018 | 6.738 | Apr 2019 | - | | 6.738 | Continuing | Continuing | Continuing |
| Developmental Test & Evaluation | SS/CPFF | HII : Newport News, VA | 5.794 | 0.000 | | 0.000 | | 0.000 | Oct 2018 | - | | 0.000 | Continuing | Continuing | Continuing |
| Developmental Test & Evaluation | SS/CPFF | JHU/ARL : Laurel, MD | 3.805 | 2.000 | Apr 2017 | 2.000 | Apr 2018 | 0.000 | Apr 2019 | - | | 0.000 | 0.000 | 7.805 | 0.305 |

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2019 Navy | | | | | | | | | | | Date: February 2018 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

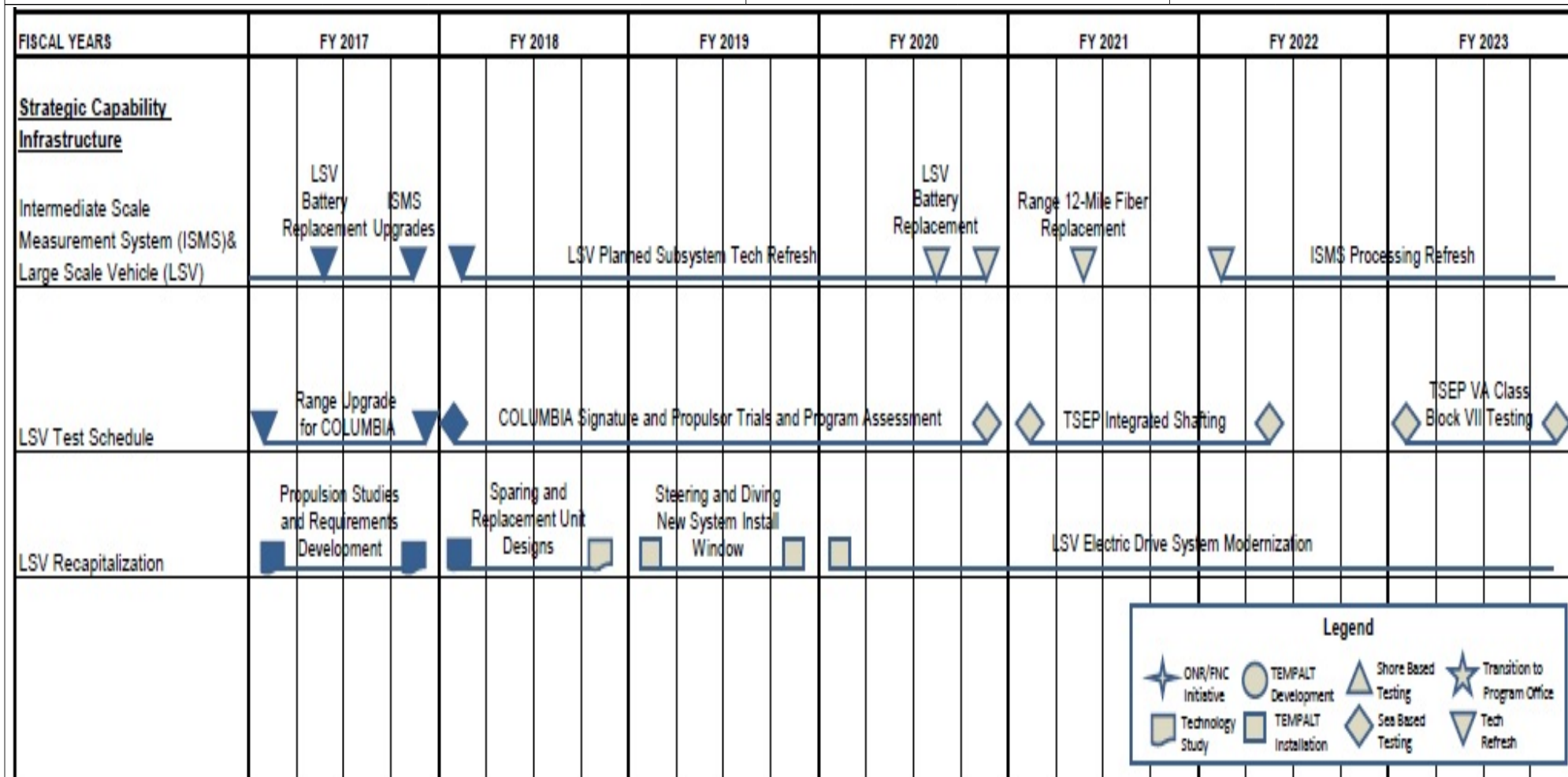| Appropriation/Budget Activity<br>1319 / 4 | R-1 Program Element (Number/Name)<br>PE 0603561N / Advanced Submarine System Development | Project (Number/Name)<br>2033 / Adv Submarine Systems Development |
|---|---|---|

**Test and Evaluation ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 | | FY 2018 | | FY 2019 Base | | FY 2019 OCO | | FY 2019 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | | | |
| Developmental Test & Evaluation | SS/CPFF | ARL/PSU : State College, PA | 0.845 | 0.000 | | 0.000 | | 0.000 | Oct 2018 | - | | 0.000 | 0.000 | 0.845 | 0.720 |
| | | Subtotal | 107.408 | 22.242 | | 16.472 | | 14.283 | | - | | 14.283 | Continuing | Continuing | N/A |

**Remarks**
Various/VAR is used to group multiple activities with small funding levels.
Activities will be incrementally funded. The award dates reflect the latest incremental portion funds will obligate.

| | Prior Years | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|
| Project Cost Totals | 447.467 | 51.684 | 35.795 | 30.685 | - | 30.685 | Continuing | Continuing | N/A |

**Remarks**

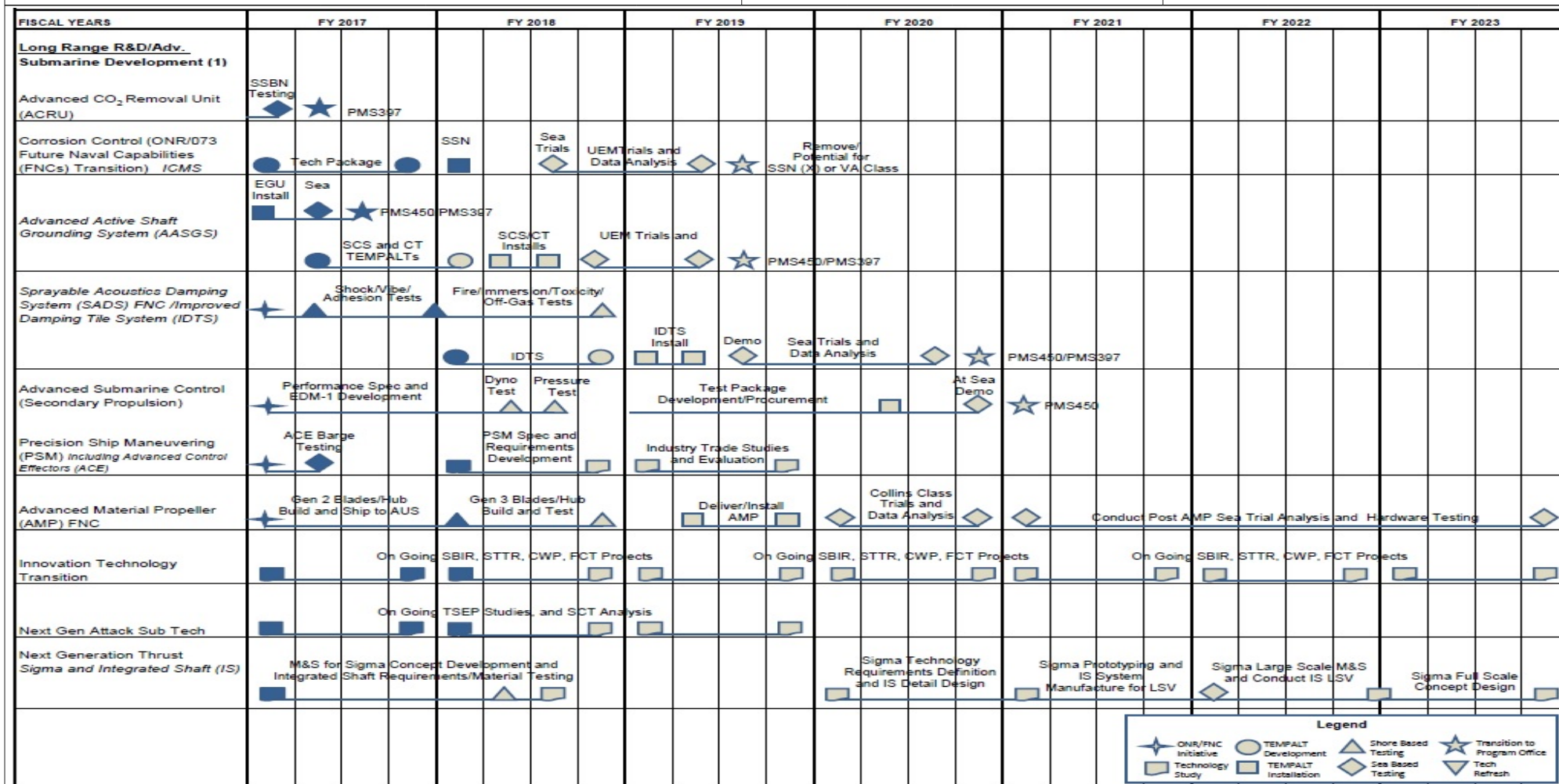| **Exhibit R-4**, **RDT&E Schedule Profile:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity** 1319 / 4 | **R-1 Program Element (Number/Name)** PE 0603561N / *Advanced Submarine System Development* | **Project (Number/Name)** 2033 / *Adv Submarine Systems Development* |

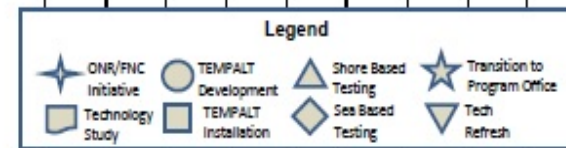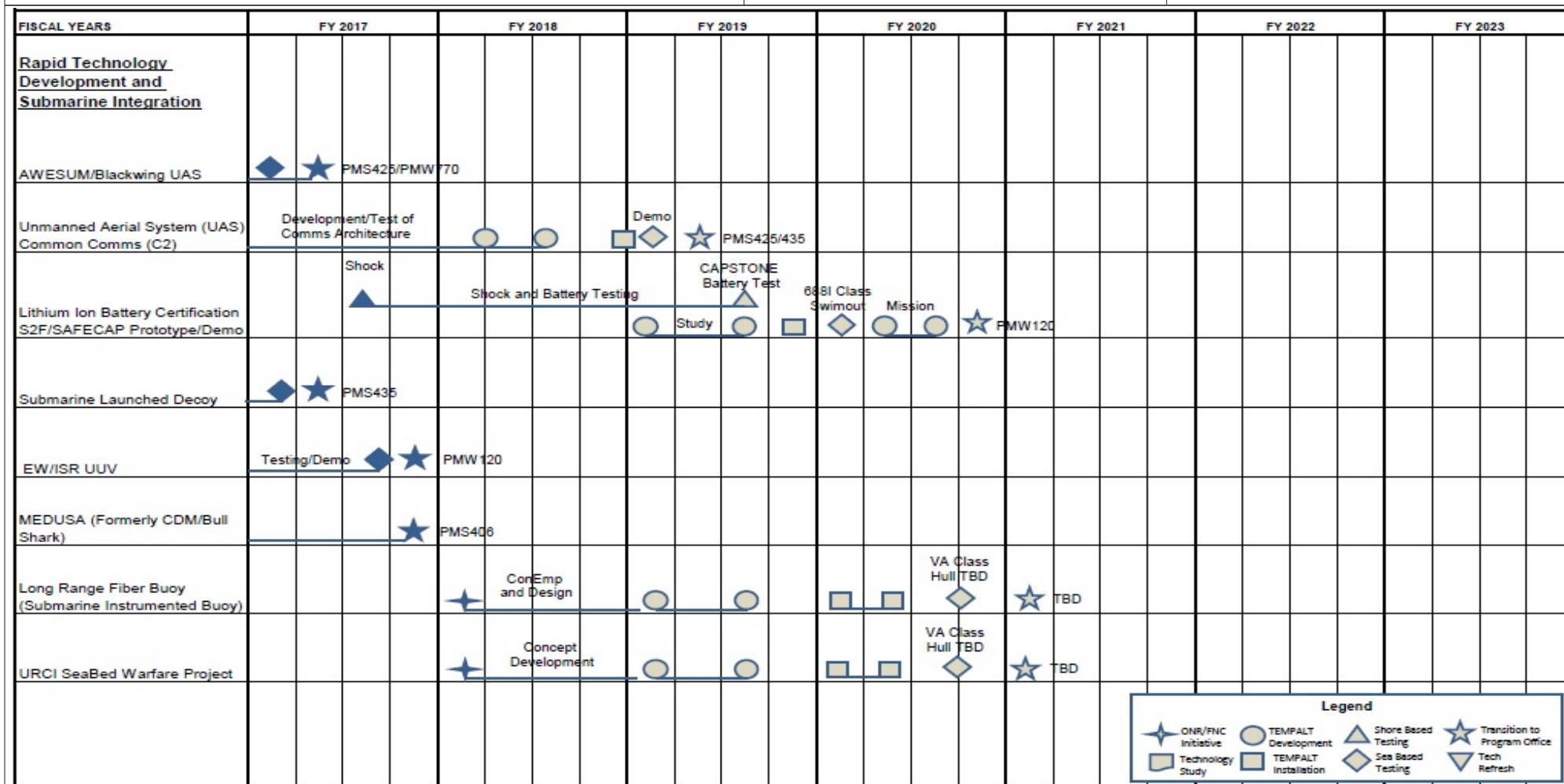| Exhibit R-4, RDT&E Schedule Profile: PB 2019 Navy | | Date: February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / *Advanced Submarine System Development* | **Project (Number/Name)**<br>2033 / *Adv Submarine Systems Development* |



Schedule chart — FISCAL YEARS FY 2017 through FY 2023

**Long Range R&D/Adv. Submarine Development (1)**

- Advanced CO$_2$ Removal Unit (ACRU): SSBN Testing, PMS397
- Corrosion Control (ONR/073 Future Naval Capabilities (FNCs) Transition) *ICMS*: Tech Package, SSN, Sea Trials, UEM Trials and Data Analysis, Remove/Potential for SSN (X) or VA Class
- *Advanced Active Shaft Grounding System (AASGS)*: EGU Install, Sea, PMS450/PMS397, SCS and CT TEMPALTs, SCS/CT Installs, UEM Trials and, PMS450/PMS397
- *Sprayable Acoustics Damping System (SADS) FNC /Improved Damping Tile System (IDTS)*: Shock/Vibe/Adhesion Tests, Fire/Immersion/Toxicity/Off-Gas Tests, IDTS, IDTS Install, Demo, Sea Trials and Data Analysis, PMS450/PMS397
- Advanced Submarine Control (Secondary Propulsion): Performance Spec and EDM-1 Development, Dyno Test, Pressure Test, Test Package Development/Procurement, At Sea Demo, PMS450
- Precision Ship Maneuvering (PSM) *Including Advanced Control Effectors (ACE)*: ACE Barge Testing, PSM Spec and Requirements Development, Industry Trade Studies and Evaluation
- Advanced Material Propeller (AMP) FNC: Gen 2 Blades/Hub Build and Ship to AUS, Gen 3 Blades/Hub Build and Test, Deliver/Install AMP, Collins Class Trials and Data Analysis, Conduct Post AMP Sea Trial Analysis and Hardware Testing
- Innovation Technology Transition: On Going SBIR, STTR, CWP, FCT Projects
- Next Gen Attack Sub Tech: On Going TSEP Studies, and SCT Analysis
- Next Generation Thrust *Sigma and Integrated Shaft (IS)*: M&S for Sigma Concept Development and Integrated Shaft Requirements/Material Testing, Sigma Technology Requirements Definition and IS Detail Design, Sigma Prototyping and IS System Manufacture for LSV, Sigma Large Scale M&S and Conduct IS LSV, Sigma Full Scale Concept Design

**Legend**
- ONR/FNC Initiative
- Technology Study
- TEMPALT Development
- TEMPALT Installation
- Shore Based Testing
- Sea Based Testing
- Transition to Program Office
- Tech Refresh

| **Exhibit R-4**, **RDT&E Schedule Profile:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>2033 *I Adv Submarine Systems Development* |

| Exhibit R-4, RDT&E Schedule Profile: PB 2019 Navy | | Date: February 2018 |
|---|---|---|
| Appropriation/Budget Activity<br>1319 / 4 | R-1 Program Element (Number/Name)<br>PE 0603561N / Advanced Submarine System Development | Project (Number/Name)<br>2033 / Adv Submarine Systems Development |

| **Exhibit R-4A**, **RDT&E Schedule Details:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>2033 *I Adv Submarine Systems Development* |

## Schedule Details

| | Start | | End | |
|---|---|---|---|---|
| **Events by Sub Project** | **Quarter** | **Year** | **Quarter** | **Year** |
| ***Proj 2033*** | | | | |
| Strategic Capability Infrastructure: ISMS/LSV - ISMS Upgrades | 1 | 2017 | 4 | 2017 |
| Strategic Capability Infrastructure: ISMS/LSV - LSV Planned Subsystem Tech Refresh | 1 | 2018 | 4 | 2020 |
| Strategic Capability Infrastructure: ISMS/LSV - Range fiberoptic replacement | 2 | 2021 | 2 | 2021 |
| Strategic Capability Infrastructure: ISMS/LSV - ISMS Tech Refresh | 1 | 2022 | 4 | 2022 |
| Strategic Capability Infrastructure: ISMS /LSV - Sustainment, Maintenance,Crew Qualification and Operations | 1 | 2017 | 4 | 2022 |
| Strategic Capability Infrastructure: ISMS /LSV - Battery Replacement (BR) | 3 | 2017 | 3 | 2017 |
| Strategic Capability Infrastructure: ISMS /LSV - BR | 3 | 2020 | 3 | 2020 |
| Strategic Capability Infrastructure: LSV Test Schedule - Range Upgrade for LSV | 1 | 2017 | 4 | 2017 |
| Strategic Capability Infrastructure: LSV Test Schedule - Propeller Testing | 1 | 2018 | 1 | 2019 |
| Strategic Capability Infrastructure: LSV Test Schedule - ONR/ORP Test | 2 | 2019 | 4 | 2021 |
| Strategic Capability Infrastructure: LSV Recapitalization - Installation and Testing Window | 1 | 2022 | 4 | 2022 |
| Long Range R&D/Advanced Submarine Development: Advanced CO2 Removal Unit (ACRU) - Remove SSBN Shipboard Test Cube | 1 | 2017 | 1 | 2017 |
| Long Range R&D/Advanced Submarine Development: Corrosion Control - ICMS - Install ICMS TEMPALT. Complete Pierside and EM trials planning | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: Corrosion Control - ICMS - Perform pierside testing and EM Trial TEMPALT | 1 | 2018 | 4 | 2018 |
| Long Range R&D/Advanced Submarine Development: Corrosion Control - AASGS - Monitor EGU TEMPALT at-sea. Install SCS and CT TEMPALTs. Complete SCS and CT Pierside and EM trial TEMPALT planning | 1 | 2017 | 4 | 2017 |

| **Exhibit R-4A**, **RDT&E Schedule Details:** PB 2019 Navy | | | | | **Date:** February 2018 | |
|---|---|---|---|---|---|---|
| **Appropriation/Budget Activity**<br>1319 **/** 4 | | **R-1 Program Element (Number/Name)**<br>PE 0603561N **/** *Advanced Submarine System Development* | | | **Project (Number/Name)**<br>2033 **/** *Adv Submarine Systems Development* | |

| | Start | | End | |
|---|---|---|---|---|
| **Events by Sub Project** | **Quarter** | **Year** | **Quarter** | **Year** |
| Long Range R&D/Advanced Submarine Development: Corrosion Control - AASGS - Remove EGU TEMPALT. Perform pierside and EM trial, SCS and CT TEMPALT testing | 1 | 2018 | 4 | 2018 |
| Long Range R&D/Advanced Submarine Development: Corrosion Control - AASGS - Remove TEMPALTS and analyze data | 1 | 2019 | 4 | 2019 |
| Long Range R&D/Advanced Submarine Development: Advanced Submarine Control - (ASC) - Develop CONOPS and performance specification and testing. Initiate Shipboard Integration | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: Advanced Material Propeller - US and Australia Collaborative Project | 1 | 2017 | 4 | 2022 |
| Long Range R&D/Advanced Submarine Development: Advanced Material Propeller - Manufacture and test Gen 3 blades and hub | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: Advanced Material Propeller (AMP) - Deliver AMP to Australia and test at-sea, study multi-material | 1 | 2018 | 4 | 2018 |
| Long Range R&D/Advanced Submarine Development: Advanced Material Propeller (AMP) - Assess roto blade at-sea, continue study of multi-material | 1 | 2019 | 4 | 2019 |
| Long Range R&D/Advanced Submarine Development: Advanced Material Propeller (AMP) - Demo roto blade at-sea, continue study of multi-material | 1 | 2020 | 4 | 2020 |
| Long Range R&D/Advanced Submarine Development: Advanced Material Propeller (AMP) - Build 2nd LSV multi-material rotor, design full scale rotor | 1 | 2021 | 4 | 2021 |
| Long Range R&D/Advanced Submarine Development: Advanced Material Propeller (AMP) - Demo 2nd LSV rotor full-scale multi-material rotor | 1 | 2022 | 4 | 2022 |
| Long Range R&D/Advanced Submarine Development: Innovation Technolology Transition (SBIR transition) - New Design Concept Dev.,/Sys. improvement. Transition SBIR and IRAD projects | 1 | 2017 | 4 | 2022 |
| Long Range R&D/Advanced Submarine Development: SSN(X) - Roadmapping technology developnent for the next submarine class | 1 | 2017 | 4 | 2022 |
| Long Range R&D/Advanced Submarine Development: Next Generation Thrust (NGT) | 1 | 2017 | 4 | 2022 |

| **Exhibit R-4A**, **RDT&E Schedule Details:** PB 2019 Navy | | | | **Date:** February 2018 | |
|---|---|---|---|---|---|
| **Appropriation/Budget Activity**<br>1319 **/** 4 | | | **R-1 Program Element (Number/Name)**<br>PE 0603561N **/** *Advanced Submarine System Development* | **Project (Number/Name)**<br>2033 **/** *Adv Submarine Systems Development* | |

| | **Start** | | **End** | |
|---|---|---|---|---|
| **Events by Sub Project** | **Quarter** | **Year** | **Quarter** | **Year** |
| Long Range R&D/Advanced Submarine Development: Electromagnetic Signatures Project Arrangement with UK & Advanced Signature Management FNC | 1 | 2017 | 4 | 2022 |
| Long Range R&D/Advanced Submarine Development: Advanced Hull Coatings - Joint US/UK Coatings Development and Modeling | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: Advanced Hull Coatings - Transition ONR Future Naval Capability (FNC) Hull Coatings | 1 | 2017 | 4 | 2022 |
| Long Range R&D/Advanced Submarine Development: Advanced Hull Coatings - Develp OPALT Treatment pkg and begin Long Lead Procurement | 2 | 2017 | 2 | 2017 |
| Long Range R&D/Advanced Submarine Development: Advanced Hull Coatings - Finalize Requirements and Treatment Configuration | 3 | 2017 | 2 | 2018 |
| Long Range R&D/Advanced Submarine Development: Advanced Hull Coatings - Treatment Installation, conduct at-sea test on VA Class Submarine | 3 | 2018 | 4 | 2019 |
| Long Range R&D/Advanced Submarine Development: Advanced Hull Coatings - Data Analysis | 1 | 2020 | 4 | 2022 |
| Long Range R&D/Advanced Submarine Development: Towed Array Reliability Improvement FNC - Conduct at-sea testing and update software tools | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: Towed Array Reliability Improvement FNC - Develop and validate software Tools for Predicting Array Operational Loading & Distribution (FNC) | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: Advanced Signature Management FNC | 1 | 2019 | 1 | 2022 |
| Long Range R&D/Advanced Submarine Development: Longe Range FIber Buoy | 1 | 2017 | 4 | 2019 |
| Long Range R&D/Advanced Submarine Development: SSN/SSGN (S3P) - Address gaps in stealth and survivability for SSN and SSGNs | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: Operational Survivability Assessment - Annual assessment of states of S3P with respect to adversary capability and available science | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: Operational Survivability - Assessment of SSN/SSGN acoustic health as requested by the SOG | 1 | 2017 | 4 | 2017 |

| Exhibit R-4A, RDT&E Schedule Details: PB 2019 Navy | | | | | Date: February 2018 | |
|---|---|---|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 4 | | | R-1 Program Element (Number/Name)<br>PE 0603561N / Advanced Submarine<br>System Development | | Project (Number/Name)<br>2033 / Adv Submarine Systems<br>Development | |

| Events by Sub Project | Start | | End | |
|---|---|---|---|---|
| | Quarter | Year | Quarter | Year |
| Long Range R&D/Advanced Submarine Development: Non-Acoustic Assessment - Assessment of SSN/SSGN non-acoustic health as requested by the SOG | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: SAS Sea Testing - Sub vs. Sub Sea Testing | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: Communication - Model, Test and Analysis | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: Fixed Arrays - Sea Test and Analysis | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: Sea Test Validation Program - Sea Test and Analysis | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: PELAGOS - Commence Project to Program of Record, Initiate VA Tactical version/configuration | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: Submarine Acoustic Superiority (SAS) - Utility Analysis | 1 | 2017 | 4 | 2017 |
| Long Range R&D/Advanced Submarine Development: Countermeasure #1 Development - Update Algorithms | 1 | 2017 | 4 | 2017 |
| Rapid Technology Development and Submarine Integration: AWESUM JCTD - Collaboration on Unmanned Aerial System (UAS) with UK/AUS/Future payload integration | 1 | 2017 | 4 | 2022 |
| Rapid Technology Development and Submarine Integration: Lithium Ion Battery Certification -Complete testing, certification approval, fabrication, TEMPALT TDP | 1 | 2017 | 4 | 2017 |
| Rapid Technology Development and Submarine Integration: Lithium Ion Battery Certification - Approve TEMPALT, conduct at-sea demo. Transition to Battlespace Awareness and Information Operations | 1 | 2018 | 4 | 2018 |
| Rapid Technology Development and Submarine Integration: Submarine Launch Decoy - Mature configuration and conduct At-Sea Test | 1 | 2017 | 4 | 2017 |
| Rapid Technology Development and Submarine Integration: EW/ISR UUV - Demo an autonomous mission capability for EW/ISR | 1 | 2017 | 4 | 2017 |

**UNCLASSIFIED**

| Exhibit R-4A, RDT&E Schedule Details: PB 2019 Navy | | | | Date: February 2018 | |
|---|---|---|---|---|---|

| Appropriation/Budget Activity<br>1319 / 4 | R-1 Program Element (Number/Name)<br>PE 0603561N / Advanced Submarine System Development | Project (Number/Name)<br>2033 / Adv Submarine Systems Development |
|---|---|---|

| Events by Sub Project | Start | | End | |
|---|---|---|---|---|
| | Quarter | Year | Quarter | Year |
| Rapid Technology Development and Submarine Integration: Common Unmanned Aerial System (UAS) Coms | 1 | 2017 | 4 | 2018 |
| Rapid Technology Development and Submarine Integration: Clanedestine Delivered Mine (CDM) - Develop, integrate and test CDM | 1 | 2017 | 1 | 2019 |
| Rapid Technology Development and Submarine Integration: Payload Integration - Innovative Payload Concepts | 1 | 2017 | 4 | 2022 |

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | | | | | | | | | Date: February 2018 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Appropriation/Budget Activity**<br>1319 I 4 | | | | **R-1 Program Element (Number/Name)**<br>PE 0603561N I Advanced Submarine<br>System Development | | | | | **Project (Number/Name)**<br>2096 I Payload Delivery Development | | |

| COST ($ in Millions) | Prior Years | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total | FY 2020 | FY 2021 | FY 2022 | FY 2023 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2096: *Payload Delivery Development* | 0.000 | 3.800 | 15.738 | 22.956 | - | 22.956 | 22.887 | 12.659 | 10.188 | 14.012 | Continuing | Continuing |
| Quantity of RDT&E Articles | | - | - | - | - | - | - | - | - | - | | |

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

Payload Delivery Development is a non-acquisition program that supports innovative research and development efforts to enable integration of deployable and/or retrievable undersea vehicles, payload concepts, and offboard systems through design, manufacture, test/demonstration, evaluation, and validation for submarine platforms. In addition to technology development, the program will support engineering and integration of new and existing technologies to enable rapid prototyping and fielding of capabilities which will inform and provide solutions to urgent war-fighter needs. Experimentation will be conducted with the Fleet (i.e., Commander, Naval Submarine Forces (COMSUBFOR), Unmanned Undersea Vehicle Squadron One (UUVRON ONE), etc.), enabling an agile environment through at-sea demonstrations, which will provide Fleet and acquisition stakeholders with relevant payload employment data to inform Concepts of Operations (CONOPs) and fielding decisions. The program will furthermore support transition of high-interest systems and/or payloads from research and development to Programs of Record (PoRs), as appropriate.

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| ***Title:*** Payload Handling System (PHS) | 3.800 | 9.038 | 17.869 | 0.000 | 17.869 |
| **Articles:** | - | - | - | - | - |

*Description:* PHS is used to enable the integration of large deployable and retrievable undersea vehicles, payloads, and offboard systems with large diameter vertical tubes primarily on guided missile (SSGN) and subsequently VIRGINIA class Block V and future submarines. PHS will initially be installed on an SSGN platform to establish proof of concept and demonstrate vertical stowage, launch and recovery capability, and integration for operational employment to influence VIRGINIA Payload Module design. Subsequent PHS application on VIRGINIA Class Block V and future submarines will support fully integrated vertical stowage, launch and recovery capability as a Fleet asset, and operational employment.

PHS funding will be used to design, manufacture, and field an integrated system to enable vertical stowage, launch and recovery of systems such as the U.S. Navy's Unmanned Undersea Vehicles (UUVs) Family of Systems (FoS) from submarines, a capability which does not currently exist. The PHS will allow the Submarine Force the flexibility to launch and recover advanced systems of various configurations, including the U.S. Navy's UUVs FoSs, in support of critical Undersea Warfare (USW) missions, providing persistent presence and payload capacity. Launch and recovery of the U.S. Navy's UUVs FoSs from submarines will provide critical battle space awareness and extend war-fighting reach as a force multiplier complementary to the fast attack

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | Date: February 2018 | | |
|---|---|---|---|---|
| **Appropriation/Budget Activity**<br>1319 I 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N I *Advanced Submarine System Development* | **Project (Number/Name)**<br>2096 I *Payload Delivery Development* | | |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| submarine (SSN) fleet. This capability is paramount to countering evolving threats from emerging world powers and maintaining dominance in the undersea domain.<br><br>***FY 2018 Plans:***<br>Continue NRE to support completion of PDR and transition into critical design of the PHS. Post-PDR plans include transition into a critical design phase, culminating in a critical design review (CDR) planned for late FY19. Approval of design maturity at CDR will support manufacturing, testing, and installation of a PHS onboard an SSGN from FY20 through FY23. Additionally, engineering support for VIRGINIA Class Block V submarine payload integration will allow the establishment of a complete, inclusive technical baseline for the VIRGINIA Payload Module (VPM) that accommodates future payloads and eliminates risk associated with costly and lengthy alterations that would be required to enable hosting of payloads.<br><br>Specific FY18 tasks required for critical design are as follows:<br>- Payload Handling Element Material Friction Test<br>- Completion of PDR<br>- Commence Critical Design<br>- Payload Handling Element Detailed Design<br>- Hydraulic System Detailed Design<br>- Electrical and Control System Detailed Design<br>- System Schematic and Diagram update based on detailed design<br>- System Arrangement based on detailed design<br>- Detailed Structural Analysis<br>- Detailed Hydrodynamic Load Case Modeling/Analysis<br>- Detailed Shock Modeling/Analysis<br>- Interface Control Documentation<br>- Component Specification Development<br>- Long Lead Material Identification<br>- Manufacturing Cost Estimate Development<br>- Build Strategy Development<br>- Operating Procedure Development<br>- Hazard Assessment Development | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | | Date: February 2018 | | |
|---|---|---|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | | **Project (Number/Name)**<br>2096 *I Payload Delivery Development* | |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| - Failure Modes and Effects Analysis | | | | | |

**FY 2019 Base Plans:**
Continue NRE to support completion of CDR, complete specification development, and execute long lead time material procurements to support transition into manufacturing and testing of the PHS. Approval of design maturity at CDR will support manufacturing, testing, and installation of a PHS onboard an SSGN from FY20 through FY23.

Specific FY19 tasks required for critical design are as follows:
- Payload Handling Element Detailed Design
- Hydraulic System Detailed Design
- Electrical and Control System Detailed Design
- System Schematic and Diagram update based on Detailed Design
- System Arrangement based on Detailed Design
- Detailed Structural Analysis
- Detailed Hydrodynamic Load Case Modeling/Analysis
- Detailed Shock Modeling/Analysis
- Interface Control Documentation
- Component Specification Development
- Long Lead Material Identification
- Long Lead Material Procurement
- Manufacturing Cost Estimate Development
- Build Strategy Development
- Operating Procedure Development
- Hazard Assessment Development
- Failure Modes and Effects Analysis

**FY 2019 OCO Plans:**
N/A

**FY 2018 to FY 2019 Increase/Decrease Statement:**
Program growth from FY18 to FY19 is required for Long Lead Time Material (LLTM) procurement in order to maintain schedule for installation and testing onboard an SSGN. Additional program growth includes component prototype development and testing, and design and engineering team support. LLTM purchases must be

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | Date: February 2018 | |
|---|---|---|---|
| **Appropriation/Budget Activity**<br>1319 I 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N I *Advanced Submarine System Development* | **Project (Number/Name)**<br>2096 I *Payload Delivery Development* | |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| executed in FY19 to support FY20 construction start. Project requires engineering support to facilitate payload integration design efforts on SSGNs and facilitate forward compatibility with VIRGINIA Class Block V submarines with the Virginia Payload Module (VPM). The nominal level of design and integration tasking planned for FY18 will be increased in FY19 to support development of design products which will comprise the technical package for critical design review (CDR) in FY20. | | | | | |
| *Title:* 3 Inch Submarine Launched Unmanned Aerial System<br><br>Articles: | 0.000<br>- | 6.700<br>- | 5.087<br>- | 0.000<br>- | 5.087<br>- |

*Description:* The 3" Submarine Launched Unmanned "K" Aerial System (SL-UKAS) project supports the future missions of the VIRGINIA Class Program and its payload module. The project will focus on the overall design, system engineering, prototyping, demonstrations, and qualification activities needed to execute the integration of a "K" payload with a 3" UAS vehicle for rapid deployment with an integrated solution into existing shipboard systems. This system will be demonstrated at a land based facility and at sea by the end of FY20. Capability will transition to the Submarine Combat Control System Program Office (PMS 425) in FY20.

The following key activities of the 3" SL-UKAS project support a critical capability for USW missions by providing close-in defense for the Submarine Force against adversary systems:

1. Engineering and integration of existing/proven technology and payloads required to provide a much needed capability to maintain dominance in the undersea domain and extend the operational reach of the Submarine Fleet.
2. Testing and demonstrations necessary to prove out the capability and define CONOPs.
3. Development/testing "safe arm mechanism" to safely stow proposed equipment types onboard submarines.

*FY 2018 Plans:*
Initiate rapid prototyping and system engineering efforts required for integration of a "K" payload with an existing 3" UAS vehicle design (including review and modification of system requirements, communications, interface and drawings for payload equipment, and system and subsystem detailed design).

Start/Complete the following Preliminary Design efforts:
- Complete prototype contract via Other Transaction Agreement (OTA)
- Define system requirements to modify the existing unmanned aerial vehicle(s) and canister with the new payload to minimize major design changes and ensure system safety

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | Date: February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>2096 *I Payload Delivery Development* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| - Design modifications to change the initial UAS vehicle to a more modular design which will increase reliability of the vehicle and streamline production manufacturing<br>- Initial payload determination and testing to ensure the payload will accomplish the current Undersea Warfare (USW) mission requirements by providing close-in defense and over-the horizon targeting which will extend the operational reach of our submarine force<br>- Completion of Preliminary Design Review (PDR) and transition into Detailed Design with down selection of competing vehicle designs.<br><br>***FY 2019 Base Plans:***<br>Continue rapid prototyping and system engineering efforts required for integration of a "K" payload with an existing 3" UAS vehicle design (including review and modification of system requirements, communications, interface and drawings for payload equipment, and system and subsystem detailed design).<br><br>Start/Complete the following Vehicle Integration and Testing efforts:<br>- Complete Detailed Design and Critical Design Review (CDR)<br>- Long Lead Time Identification and Procurement of material.<br>- Manufacture Prototype of vehicle, canister, and "K" payload<br>- Conduct Test Readiness Review (TRR)<br>- Initiate integration testing of the vehicle, canister, and "K" payload (i.e., Vehicle Dynamics, Payload Precision, Accuracy/Targeting, WSESRB, Shock, IA, etc.)<br>- Initiate demonstration preparations in order to successfully demonstrate the UKAS vehicle with the integrated payload in FY20 (UAS test systems material procurement and builds, development of special test fixtures, and demonstration requirements)<br>***FY 2019 OCO Plans:***<br>N/A<br><br>***FY 2018 to FY 2019 Increase/Decrease Statement:***<br>Decrease from FY18 to FY19 is in accordance with planned program profile and is not due to a negative action against this effort. | | | | | |
| **Accomplishments/Planned Programs Subtotals** | 3.800 | 15.738 | 22.956 | 0.000 | 22.956 |

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

| **Exhibit R-2A**, **RDT&E Project Justification:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>2096 *I Payload Delivery Development* |

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

**Remarks**

**D. Acquisition Strategy**

Payload Delivery Development is a non-acquisition program that leverages government laboratories, field activities, and industry to enable research and development efforts in support of technology and system development, manufacture, testing, integration and fielding on submarine host platforms.  Engage with industry and utilize various contracts (i.e., Other Transaction Agreements (OTAs), sole-source, competitive) from broad solicitations as necessary to facilitate requirements, development, and production support to allow rapid integration of payloads and offboard systems. Technology solutions will transition to appropriate Acquisition Category (ACAT) Program Management Offices (PMOs).

**E. Performance Metrics**

Payload Handling System (PHS)
Completion of Preliminary Design Review (PDR). Commencement of Critical Design.

3" Sub Launched Unmanned "K" Aerial System (SL-UKAS)
Updated Master Schedule and down-select payload to final design. Development of design documentation and interface control requirements. Completion of Detailed Design Review.

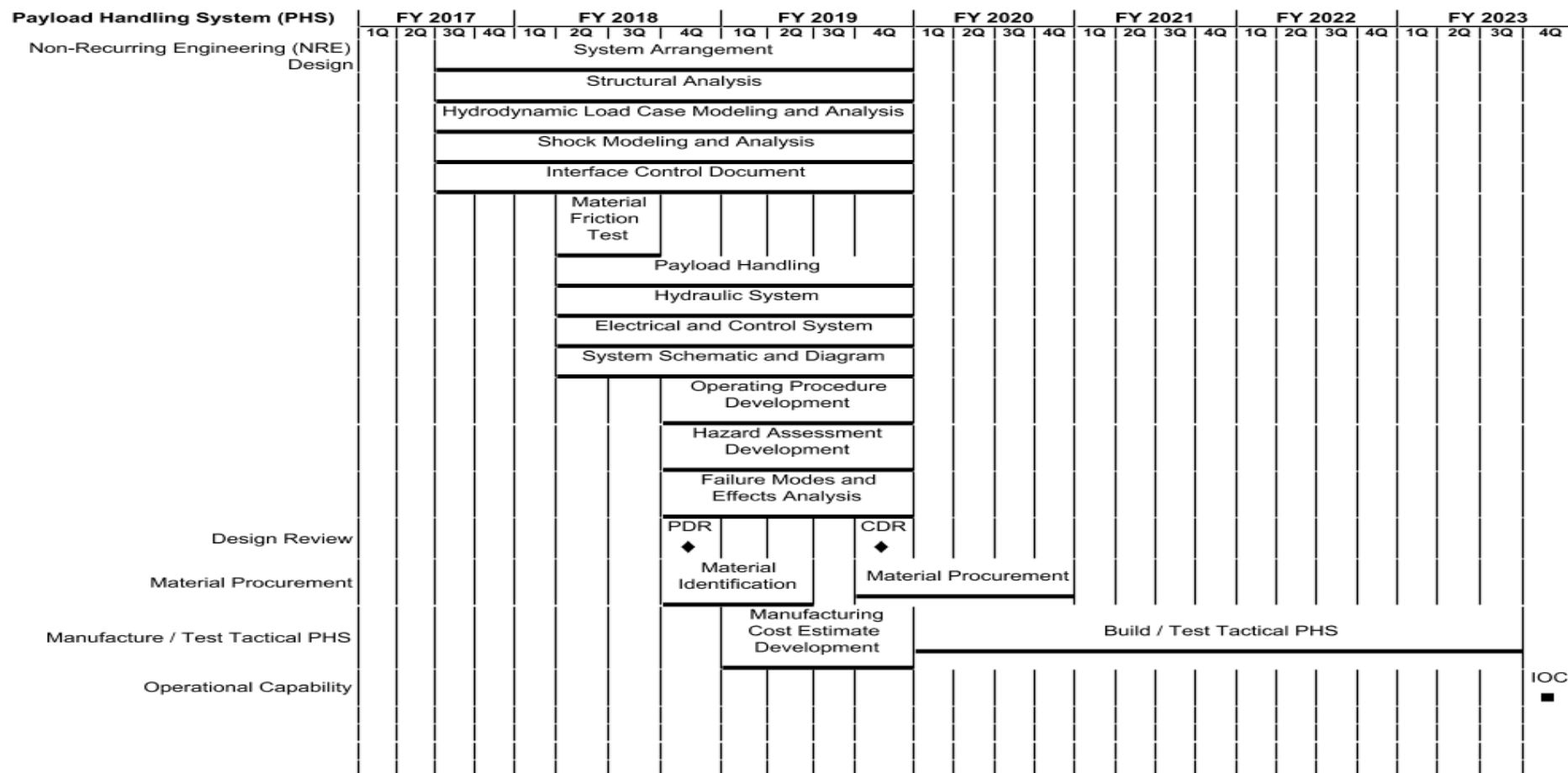| Exhibit R-3, RDT&E Project Cost Analysis: PB 2019 Navy | | Date: February 2018 |
|---|---|---|
| **Appropriation/Budget Activity** <br> 1319 / 4 | **R-1 Program Element (Number/Name)** <br> PE 0603561N / Advanced Submarine System Development | **Project (Number/Name)** <br> 2096 / Payload Delivery Development |

**Product Development ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 | | FY 2018 | | FY 2019 Base | | FY 2019 OCO | | FY 2019 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | | | |
| Product Development | WR | NUWC NPT : Newport, RI | 0.000 | 0.265 | May 2017 | 1.174 | Oct 2017 | 1.250 | Oct 2018 | - | | 1.250 | Continuing | Continuing | Continuing |
| Product Development | WR | NSWC PD : Philadelphia, PA | 0.000 | 0.904 | May 2017 | 3.275 | Oct 2017 | 6.550 | Oct 2018 | - | | 6.550 | Continuing | Continuing | Continuing |
| Product Development | WR | NUWC KPT : Keyport, WA | 0.000 | 1.110 | May 2017 | 3.325 | Oct 2017 | 5.645 | Oct 2018 | - | | 5.645 | Continuing | Continuing | Continuing |
| Product Development | WR | PSNS : Bremerton, WA | 0.000 | 0.261 | May 2017 | 1.010 | Oct 2017 | 3.950 | Oct 2018 | - | | 3.950 | Continuing | Continuing | Continuing |
| Product Development | WR | NSWC CD : West Bethesda, MD | 0.000 | 0.300 | May 2017 | 0.910 | Oct 2017 | 1.000 | Oct 2018 | - | | 1.000 | Continuing | Continuing | Continuing |
| Product Development | WR | NRL : Washington, DC | 0.000 | 0.100 | Jul 2017 | 0.200 | Oct 2017 | 0.000 | | - | | 0.000 | Continuing | Continuing | Continuing |
| Product Development | WR | NSWC DD : Dahlgren, VA | 0.000 | 0.005 | Jul 2017 | 0.021 | Oct 2017 | 0.025 | Oct 2018 | - | | 0.025 | Continuing | Continuing | Continuing |
| Product Development | WR | PNS : Portsmouth, NH | 0.000 | 0.527 | Dec 2017 | 0.649 | Oct 2017 | 1.000 | Oct 2018 | - | | 1.000 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | AeroVironment : Simi Valley, CA | 0.000 | 0.000 | | 4.753 | Dec 2017 | 2.599 | Dec 2018 | - | | 2.599 | Continuing | Continuing | Continuing |
| | | **Subtotal** | 0.000 | 3.472 | | 15.317 | | 22.019 | | - | | 22.019 | Continuing | Continuing | N/A |

**Management Services ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 | | FY 2018 | | FY 2019 Base | | FY 2019 OCO | | FY 2019 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | Award Date | Cost | | | |
| Travel | Allot | NAVSEA HQ : Washington DC | 0.000 | 0.050 | May 2017 | 0.121 | Oct 2017 | 0.122 | Oct 2018 | - | | 0.122 | Continuing | Continuing | Continuing |
| Contractor Management Services | C/CPAF | NTT Data : McLean, VA | 0.000 | 0.278 | Aug 2017 | 0.300 | Dec 2017 | 0.815 | Dec 2018 | - | | 0.815 | Continuing | Continuing | Continuing |
| | | **Subtotal** | 0.000 | 0.328 | | 0.421 | | 0.937 | | - | | 0.937 | Continuing | Continuing | N/A |

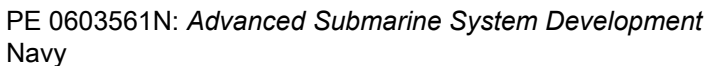| **Exhibit R-3**, **RDT&E Project Cost Analysis:** PB 2019 Navy | | | | | | | | | **Date:** February 2018 |
|---|---|---|---|---|---|---|---|---|---|
| **Appropriation/Budget Activity** <br> 1319 *I* 4 | | | | **R-1 Program Element (Number/Name)** <br> PE 0603561N *I Advanced Submarine System Development* | | | | **Project (Number/Name)** <br> 2096 *I Payload Delivery Development* | |

| | **Prior Years** | **FY 2017** | **FY 2018** | **FY 2019 Base** | **FY 2019 OCO** | **FY 2019 Total** | **Cost To Complete** | **Total Cost** | **Target Value of Contract** |
|---|---|---|---|---|---|---|---|---|---|
| **Project Cost Totals** | 0.000 | 3.800 | 15.738 | 22.956 | - | 22.956 | Continuing | Continuing | N/A |

**Remarks**

| **Exhibit R-4**, **RDT&E Schedule Profile:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>2096 *I Payload Delivery Development* |



2019PB – 0603561N – 2096

| **Exhibit R-4**, RDT&E Schedule Profile: PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>2096 *I Payload Delivery Development* |



3" Sub Launched Unmanned "K" Aerial System (SL-UKAS)

FY 2017 | FY 2018 | FY 2019 | FY 2020 | FY 2021 | FY 2022 | FY 2023

Contract with OEM: RFP, Contract Award, Detailed Design/Material Mod, Prototype Validation Demo Mod

Preliminary Design: System Requirements, CONOPS, 3, Payload Design and Test

Detailed Design: Detailed Design

Design Review: PDR, CDR, TRR

Material Procurement: LLTM, Manufacture

Demonstration: Qualification Testing, Demo Prep (Land), Demo Prep (Sea), Land Based Demonstration, Sea Based Demonstration

Test Report: Land Based Report, Sea Based Report

Initial Operational Capability: IOC

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| Exhibit R-4A, RDT&E Schedule Details: PB 2019 Navy | | | | Date: February 2018 | |
|---|---|---|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | | **Project (Number/Name)**<br>2096 *I Payload Delivery Development* | |

## Schedule Details

| Events by Sub Project | Start | | End | |
|---|---|---|---|---|
| | **Quarter** | **Year** | **Quarter** | **Year** |
| **Payload Handling System (PHS)** | | | | |
| Non-Recurring Engineering (NRE) Design: System Arrangement Development | 3 | 2017 | 4 | 2019 |
| Non-Recurring Engineering (NRE) Design: Structural Analysis | 3 | 2017 | 4 | 2019 |
| Non-Recurring Engineering (NRE) Design: Hydrodynamic Load Case Modeling and Analysis | 3 | 2017 | 4 | 2019 |
| Non-Recurring Engineering (NRE) Design: Shock Modeling and Analysis | 3 | 2017 | 4 | 2019 |
| Non-Recurring Engineering (NRE) Design: Interface Control Document | 3 | 2017 | 4 | 2019 |
| Non-Recurring Engineering (NRE) Design: Payload Handling Element Material Friction Test | 2 | 2018 | 3 | 2018 |
| Non-Recurring Engineering (NRE) Design: Payload Handling Element Design Development | 2 | 2018 | 4 | 2019 |
| Non-Recurring Engineering (NRE) Design: Hydraulic System Design Development | 2 | 2018 | 4 | 2019 |
| Non-Recurring Engineering (NRE) Design: Electrical and Control System Design Development | 2 | 2018 | 4 | 2019 |
| Non-Recurring Engineering (NRE) Design: System Schematic and Diagram Development | 2 | 2018 | 4 | 2019 |
| Non-Recurring Engineering (NRE) Design: Operating Procedure Development | 4 | 2018 | 4 | 2019 |
| Non-Recurring Engineering (NRE) Design: Hazard Assessment Development | 4 | 2018 | 4 | 2019 |
| Non-Recurring Engineering (NRE) Design: Failure Modes and Effects Analysis | 4 | 2018 | 4 | 2019 |
| Design Review: Preliminary Design Review | 4 | 2018 | 4 | 2018 |
| Design Review: Critical Design Review | 4 | 2019 | 4 | 2019 |
| Material Procurement: Material Identification | 4 | 2018 | 2 | 2019 |
| Material Procurement: Material Procurement | 4 | 2019 | 4 | 2020 |

| **Exhibit R-4A**, **RDT&E Schedule Details:** PB 2019 Navy | | | | **Date:** February 2018 | |
|---|---|---|---|---|---|
| **Appropriation/Budget Activity** 1319 *I* 4 | | **R-1 Program Element (Number/Name)** PE 0603561N *I Advanced Submarine System Development* | | **Project (Number/Name)** 2096 *I Payload Delivery Development* | |

| | Start | | End | |
|---|---|---|---|---|
| **Events by Sub Project** | **Quarter** | **Year** | **Quarter** | **Year** |
| Manufacture / Test Tactical PHS: Manufacturing Cost Estimate Development | 1 | 2019 | 4 | 2019 |
| Manufacture / Test Tactical PHS: Manufacture / Test Tactical PHS | 1 | 2020 | 3 | 2023 |
| Operational Capability: Inital Operational Capability | 4 | 2023 | 4 | 2023 |
| ***3" Sub Launched Unmanned "K" Aerial System (SL-UKAS)*** | | | | |
| Contract with OEM: Request for Proposal | 1 | 2018 | 1 | 2018 |
| Contract with OEM: Contract Award | 2 | 2018 | 2 | 2018 |
| Contract with OEM: Detailed Design/Material | 4 | 2018 | 4 | 2018 |
| Contract with OEM: Prototype Validation Demonstration(s) | 4 | 2019 | 4 | 2019 |
| Preliminary Design: System Requirements/Interfaces | 1 | 2018 | 4 | 2018 |
| Preliminary Design: CONOPS | 1 | 2018 | 4 | 2018 |
| Preliminary Design: 3" Vehicle and Canister Modification(s) | 1 | 2018 | 4 | 2018 |
| Preliminary Design: Payload Design and Test | 1 | 2018 | 4 | 2018 |
| Detailed Design: Detailed Design | 1 | 2019 | 2 | 2019 |
| Design Review: Preliminary Design Review | 4 | 2018 | 4 | 2018 |
| Design Review: Critical Design Review | 2 | 2019 | 2 | 2019 |
| Design Review: Test Readiness Review | 4 | 2019 | 4 | 2019 |
| Material Procurement: Long Lead Time Material Identification | 2 | 2019 | 2 | 2019 |
| Material Procurement: Manufacture | 2 | 2019 | 4 | 2019 |
| Material Procurement: Qualification Testing | 4 | 2019 | 2 | 2020 |
| Demonstration: Demonstration Preperation (Land Based) | 4 | 2019 | 2 | 2020 |
| Demonstration: Demonstration Preperation (Sea Based) | 1 | 2020 | 2 | 2020 |
| Demonstration: Land Based Demonstration | 2 | 2020 | 3 | 2020 |
| Demonstration: Sea Based Demonstration | 2 | 2020 | 4 | 2020 |
| Test Report: Land Based Report | 3 | 2020 | 3 | 2020 |
| Test Report: Sea Based Report | 4 | 2020 | 4 | 2020 |

| **Exhibit R-4A**, **RDT&E Schedule Details:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>2096 *I Payload Delivery Development* |

| | Start | | End | |
|---|---|---|---|---|
| **Events by Sub Project** | **Quarter** | **Year** | **Quarter** | **Year** |
| Initial Operational Capability: Initial Operational Capability | 4 | 2020 | 4 | 2020 |

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | | | | | | | | | Date: February 2018 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | | | | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | | | | | **Project (Number/Name)**<br>3391 *I SSN/SSGN Survivability Program* | | |

| COST ($ in Millions) | Prior Years | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total | FY 2020 | FY 2021 | FY 2022 | FY 2023 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3391: *SSN/SSGN Survivability Program* | 0.000 | 0.000 | 8.594 | 8.327 | - | 8.327 | 8.453 | 8.600 | 8.767 | 8.954 | Continuing | Continuing |
| Quantity of RDT&E Articles | | - | - | - | - | - | - | - | - | - | | |

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

Project 3391 SSN/SSGN Survivability Program (S3P): Project realigned in FY18. S3P previously funded under Project 2033 through FY17. The S3P is chartered by OPNAV N97 to assure SSN/SSGN survivability and the ability of submarines to complete their missions even if covert mobility is compromised.

**B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)**

| | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total |
|---|---|---|---|---|---|
| **Title:** SSN/SSGN Survivability Program | 0.000 | 8.594 | 8.327 | 0.000 | 8.327 |
| Articles: | - | - | - | - | - |

**Description:** The details of project activities are SECRET or higher. The SSN/SSGN Survivability Program (S3P) provides Director, Undersea Warfare Division (OPNAV N97) with qualitative and quantitative analysis of potential SSN and SSGN submarine vulnerabilities based on technology threats and operational requirements and recommends countermeasure concepts to mitigate these potential vulnerabilities. S3P informs the entire $10B submarine portfolio with validated analysis which informs risk to submarine stealth in contested environments. This analysis also informs methods by which stealth can be regained once compromised to execute missions such as weapons employment. S3P conducts technical analysis validated with at-sea testing. The technical analysis is put into an operational context using data from current submarine operations and also evolving Fleet war plans. S3P develops technologies and tools to increase the survivability of submarines by recognizing and mitigating sources of acoustic and non-acoustic vulnerabilities that put a submarine at risk when penetrating contested waters and operating in the littorals. S3P supports fleet development of Tactics, Techniques, and Procedures (TTPs) that facilitate new or enhance existing warfighting concepts.

**FY 2018 Plans:**
FY 2018, funding for S3P activity shifts from Project 2033 to Project 3391.

S3P will continue to address gaps in stealth and survivability for the current and future SSN/SSGN force to include responding to fleet questions on current tactical vulnerabilities and completion of an annual Operational Survivability Assessment. S3P will conduct acoustic and non-acoustic vulnerability assessment projects, and

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 **/** 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N **/** *Advanced Submarine System Development* | **Project (Number/Name)**<br>3391 **/** *SSN/SSGN Survivability Program* |

| **B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)** | **FY 2017** | **FY 2018** | **FY 2019 Base** | **FY 2019 OCO** | **FY 2019 Total** |
|---|---|---|---|---|---|
| will conduct sea tests to better characterize vulnerability and evaluate two developmental Tactical Decision Aids. Details can be provided in a classified setting.<br><br>***FY 2019 Base Plans:***<br>S3P will continue to address gaps in stealth and survivability for the current and future SSN/SSGN force to include responding to fleet questions on current tactical vulnerabilities and completion of an annual Operational Survivability Assessment.  S3P will conduct acoustic, non-acoustic, and non-traditional ASW vulnerability assessment projects, and will conduct sea tests in support of the Acoustic Superiority project along with beginning the transition of two developmental Tactical Decision Aids to programs of record.  Details can be provided in a classified setting.<br><br>***FY 2019 OCO Plans:***<br>N/A<br><br>***FY 2018 to FY 2019 Increase/Decrease Statement:***<br>Decrease from FY18 to FY19 is in accordance with planned program profile and is not due to a negative action against this effort. | | | | | |
| **Accomplishments/Planned Programs Subtotals** | 0.000 | 8.594 | 8.327 | 0.000 | 8.327 |

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

 N/A

**Remarks**


**D. Acquisition Strategy**

 S3P is a non-acquisition activity which investigates, prioritizes, and validates SSN/SSGN survivability issues for peacetime and all phases of war.  S3P also proposes and directs development and validation of countermeasure concepts. S3P works to ensure alignment between OPNAV, NAVSEA, ONI, and the Fleet on survivability issues. S3P will develop recommendations for stealth requirements to OPNAV N97 and provide technical basis for Tactics, Techniques, and Procedures developed by the Undersea Warfighting Development Command (UWDC). S3P will operate under OPNAV N97 and Fleet Flag panel (Operations Review Group) oversight. Products and metrics will be evaluated by the Submarine Operations Group and Operations Review Group. S3P will recommend technical requirements on all matters of submarine survivability to OPNAV N97.

**E. Performance Metrics**

 Conduct in-depth assessment of SSN/SSGN Survivability for peacetime and wartime operations in contested environment. Respond to emergent fleet tasking to assess real-world vulnerability concerns.  Complete annual SSN/SSGN Operational Survivability Assessment report for ORG.  Conduct 3-4 vulnerability assessments per fiscal

| **Exhibit R-2A**, **RDT&E Project Justification:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>3391 *I SSN/SSGN Survivability Program* |

year (each assessment is a 2-12 month level of effort).  Conduct 1-3 countermeasure development efforts per fiscal year (each project is a 2-3 year level of effort). Specific technical topics each year are selected based on Fleet needs (as validated by the ORG), evolving threats, and mission requirements.

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2019 Navy | | | | | | | | | | | | | **Date:** February 2018 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**Appropriation/Budget Activity**
1319 / 4

**R-1 Program Element (Number/Name)**
PE 0603561N / Advanced Submarine System Development

**Project (Number/Name)**
3391 / SSN/SSGN Survivability Program

**Product Development ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 Cost | FY 2017 Award Date | FY 2018 Cost | FY 2018 Award Date | FY 2019 Base Cost | FY 2019 Base Award Date | FY 2019 OCO Cost | FY 2019 OCO Award Date | FY 2019 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Product Development | MIPR | CNA: : Alex, VA | 0.000 | 0.000 | | 0.447 | Jan 2018 | 0.448 | Jan 2019 | - | | 0.448 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | MIT-LL : Cambridge, MA | 0.000 | 0.000 | | 0.626 | Oct 2017 | 0.627 | Oct 2018 | - | | 0.627 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | Raytheon : Portmouth, RI | 0.000 | 0.000 | | 0.308 | Oct 2017 | 0.309 | Oct 2018 | - | | 0.309 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | JHU/APL : Laurel, MD | 0.000 | 0.000 | | 2.263 | Oct 2017 | 2.137 | Oct 2018 | - | | 2.137 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | UT/ARL : Austin, TX | 0.000 | 0.000 | | 1.044 | Oct 2017 | 1.045 | Oct 2018 | - | | 1.045 | Continuing | Continuing | Continuing |
| Product Development | WR | NUWC : Newport, RI | 0.000 | 0.000 | | 1.198 | Oct 2017 | 1.159 | Oct 2018 | - | | 1.159 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | SPA : Arlington, VA | 0.000 | 0.000 | | 0.208 | Dec 2017 | 0.209 | Dec 2018 | - | | 0.209 | Continuing | Continuing | Continuing |
| Product Development | C/BA | NSMA : Not Specified | 0.000 | 0.000 | | 0.592 | Dec 2017 | 0.592 | Dec 2018 | - | | 0.592 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | Applied Mathmetics Int : Gales Ferry, CT | 0.000 | 0.000 | | 0.200 | Oct 2017 | 0.200 | Oct 2018 | - | | 0.200 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | Lambda Sciences : Alexadria, VA | 0.000 | 0.000 | | 0.200 | Oct 2017 | 0.100 | Oct 2018 | - | | 0.100 | Continuing | Continuing | Continuing |
| | | **Subtotal** | 0.000 | 0.000 | | 7.086 | | 6.826 | | - | | 6.826 | Continuing | Continuing | N/A |

**Support ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 Cost | FY 2017 Award Date | FY 2018 Cost | FY 2018 Award Date | FY 2019 Base Cost | FY 2019 Base Award Date | FY 2019 OCO Cost | FY 2019 OCO Award Date | FY 2019 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Travel and Corporate | WR | NAVSEA HQ : Not Specified | 0.000 | 0.000 | | 0.420 | Oct 2017 | 0.413 | Oct 2018 | - | | 0.413 | Continuing | Continuing | Continuing |
| | | **Subtotal** | 0.000 | 0.000 | | 0.420 | | 0.413 | | - | | 0.413 | Continuing | Continuing | N/A |

PE 0603561N: Advanced Submarine System Development
Navy

| **Exhibit R-3**, **RDT&E Project Cost Analysis:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / Advanced Submarine System Development | **Project (Number/Name)**<br>3391 / SSN/SSGN Survivability Program |

**Test and Evaluation ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 Cost | FY 2017 Award Date | FY 2018 Cost | FY 2018 Award Date | FY 2019 Base Cost | FY 2019 Base Award Date | FY 2019 OCO Cost | FY 2019 OCO Award Date | FY 2019 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Developmental Test & Evaluation | WR | NSWC : Carderock, MD | 0.000 | 0.000 | | 0.601 | Apr 2018 | 0.601 | Apr 2019 | - | | 0.601 | Continuing | Continuing | Continuing |
| **Subtotal** | | | 0.000 | 0.000 | | 0.601 | | 0.601 | | - | | 0.601 | Continuing | Continuing | N/A |

**Management Services ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 Cost | FY 2017 Award Date | FY 2018 Cost | FY 2018 Award Date | FY 2019 Base Cost | FY 2019 Base Award Date | FY 2019 OCO Cost | FY 2019 OCO Award Date | FY 2019 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Management Services | SS/CPFF | Sonalyst : Not Specified | 0.000 | 0.000 | | 0.487 | Dec 2017 | 0.487 | Dec 2018 | - | | 0.487 | Continuing | Continuing | Continuing |
| **Subtotal** | | | 0.000 | 0.000 | | 0.487 | | 0.487 | | - | | 0.487 | Continuing | Continuing | N/A |

| | Prior Years | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|
| **Project Cost Totals** | 0.000 | 0.000 | 8.594 | 8.327 | - | 8.327 | Continuing | Continuing | N/A |

**Remarks**

| Exhibit R-4, RDT&E Schedule Profile: PB 2019 Navy | | Date: February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / *Advanced Submarine System Development* | **Project (Number/Name)**<br>3391 / *SSN/SSGN Survivability Program* |

| **Exhibit R-4A**, **RDT&E Schedule Details:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 *I* 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N *I Advanced Submarine System Development* | **Project (Number/Name)**<br>3391 *I SSN/SSGN Survivability Program* |

## Schedule Details

| Events by Sub Project | Start | | End | |
|---|---|---|---|---|
| | **Quarter** | **Year** | **Quarter** | **Year** |
| ***Assessments*** | | | | |
| Operational Survivability Assessment | 1 | 2019 | 4 | 2023 |
| Acoustic Assessment | 1 | 2019 | 4 | 2023 |
| Non-Acoustic Assessment | 1 | 2019 | 4 | 2023 |
| ***Vulnerability Validation*** | | | | |
| Vulnerability Projects (3-4 per year) | 1 | 2019 | 4 | 2023 |
| Sea Test Validation Program (1-2 per year) | 1 | 2019 | 4 | 2023 |
| ***Countermeasures*** | | | | |
| Countermeasure Validation (2-3 per year) | 1 | 2019 | 4 | 2023 |

| Exhibit R-2A, RDT&E Project Justification: PB 2019 Navy | | | | | | | | | | Date: February 2018 | |
|---|---|---|---|---|---|---|---|---|---|---|---|

| Appropriation/Budget Activity<br>1319 / 4 | R-1 Program Element (Number/Name)<br>PE 0603561N / Advanced Submarine<br>System Development | Project (Number/Name)<br>9999 / Congressional Adds |
|---|---|---|

| COST ($ in Millions) | Prior Years | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total | FY 2020 | FY 2021 | FY 2022 | FY 2023 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9999: Congressional Adds | 0.000 | 24.179 | 0.000 | 0.000 | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 24.179 |
| Quantity of RDT&E Articles | | - | - | - | - | - | - | - | - | - | | |

### A. Mission Description and Budget Item Justification

Develop a full-scale prototype Advanced Material Propeller (AMP)for demonstration on a Royal Australian Navy submarine.  Develop future propulsor design concepts and Next Generation (NG) Thrust technologies.  Develop and demonstrate alternative and advanced materials for new integrated shaft and propulsor designs.

### B. Accomplishments/Planned Programs ($ in Millions)

| | FY 2017 | FY 2018 |
|---|---|---|
| *Congressional Add:* Advanced Materials Propeller Research | 24.179 | 0.000 |
| *FY 2017 Accomplishments:* Completed AMP Structural Certification Plan to obtain approvals from US and AUS authorities that propeller is acceptable for at sea test.  Complete testing of AMP Gen 2 full scale hardware to validate acceptance predictions. | | |
| *FY 2018 Plans:* Complete manufacture of the Advanced Material Propeller (AMP) trial propeller and collection of Objective Quality Evidence (OQE) to support approval of hardware for the sea trial acceptance package.  Finalize AMP trial planning and run prioritization in support of US-AUS project arrangement.  Complete AMP instrumentation, tool validation and load predictions.  Define and evaluate new/alternative Next Generation Thrust (NGT) technologies, perform advanced material studies, develop design simulation tools and define system concepts.  Develop an integrated shaft and propulsor design concept and prototype using advanced materials for large scale vehicle demonstration. | | |
| **Congressional Adds Subtotals** | 24.179 | 0.000 |

### C. Other Program Funding Summary ($ in Millions)
N/A

### Remarks

### D. Acquisition Strategy
N/A

### E. Performance Metrics
Complete all required testing and obtain approvals n the AMP Structural Certification Plan.

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2019 Navy | | | | | | | | | | | | | Date: February 2018 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | | | | | | **R-1 Program Element (Number/Name)**<br>PE 0603561N / Advanced Submarine System Development | | | | | **Project (Number/Name)**<br>9999 / Congressional Adds | | | | |

**Product Development ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 Cost | FY 2017 Award Date | FY 2018 Cost | FY 2018 Award Date | FY 2019 Base Cost | FY 2019 Base Award Date | FY 2019 OCO Cost | FY 2019 OCO Award Date | FY 2019 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Product Development | C/CPFF | Seemann Composites Inc : Gulf Port, MS | 0.000 | 13.420 | Sep 2017 | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 13.420 | - |
| Product Development | C/CPIF | Rolls Royce Marine : Walpole, MA | 0.000 | 4.563 | Sep 2017 | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 4.563 | - |
| Product Development | C/CPFF | Electric Boat : Groton, CT | 0.000 | 0.175 | Jul 2017 | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 0.175 | - |
| Product Development | C/CPFF | BAH : Manassas, VA | 0.000 | 0.075 | Jul 2017 | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 0.075 | - |
| Product Development | C/CPFF | Alion : Washington, DC | 0.000 | 0.598 | Jul 2017 | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 0.598 | - |
| Product Development | C/CPFF | ARL/PSU : Groton, CT | 0.000 | 2.277 | Sep 2017 | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 2.277 | - |
| Product Development | C/CPFF | ARL/JHU : Columbia, MD | 0.000 | 0.090 | Sep 2017 | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 0.090 | - |
| Product Development | Various | NSWC/CD : Bethesda, MD | 0.000 | 2.881 | Jul 2017 | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 2.881 | - |
| Product Development | Various | NSWC/Philadelphia : Philadelphia, PA | 0.000 | 0.075 | Jul 2017 | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 0.075 | - |
| Product Development | Various | NRL : Washington, DC | 0.000 | 0.025 | Jul 2017 | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 0.025 | - |
| | | **Subtotal** | 0.000 | 24.179 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 24.179 | N/A |

**Test and Evaluation ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2017 Cost | FY 2017 Award Date | FY 2018 Cost | FY 2018 Award Date | FY 2019 Base Cost | FY 2019 Base Award Date | FY 2019 OCO Cost | FY 2019 OCO Award Date | FY 2019 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Test and Evaluation | SS/CPFF | Not Specified : Not Specified | 0.000 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 0.000 | - |
| | | **Subtotal** | 0.000 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 0.000 | N/A |

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2019 Navy | | | | | | | | | Date: February 2018 |
|---|---|---|---|---|---|---|---|---|---|

| Appropriation/Budget Activity<br>1319 / 4 | | R-1 Program Element (Number/Name)<br>PE 0603561N / *Advanced Submarine System Development* | | Project (Number/Name)<br>9999 / *Congressional Adds* |
|---|---|---|---|---|

| | Prior Years | FY 2017 | FY 2018 | FY 2019 Base | FY 2019 OCO | FY 2019 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|
| Project Cost Totals | 0.000 | 24.179 | 0.000 | 0.000 | - | 0.000 | 0.000 | 24.179 | N/A |

**Remarks**

| **Exhibit R-4**, RDT&E Schedule Profile: PB 2019 Navy | **Date:** February 2018 |
|---|---|
| **Appropriation/Budget Activity**<br>1319 **/** 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N **/** *Advanced Submarine System Development* | **Project (Number/Name)**<br>9999 **/** *Congressional Adds* |

| | FY 2017 | | | | FY 2018 | | | | FY 2019 | | | | FY 2020 | | | | FY 2021 | | | | FY 2022 | | | | FY 2023 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| ***Proj 9999*** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Advanced Materials Propeller Research: Advanced Material Propeller Development, Fabrication and Testing | | | | ▬▬▬▬▬▬ | | | | | | | | | | | | | | | | | | | | | | | | |
| Advanced Materials Propeller Research: Advanced Material Propeller Instrumentation and Tool Validation | | | | ▬▬▬▬▬▬ | | | | | | | | | | | | | | | | | | | | | | | | |
| Advanced Materials Propeller Research: Advanced Material Propeller Load Predictions | | | | ▬▬▬▬▬▬ | | | | | | | | | | | | | | | | | | | | | | | | |
| Advanced Materials Propeller Research: Next Generaltion Thrust Concept Development and Testing | | | | ▬▬▬▬▬▬ | | | | | | | | | | | | | | | | | | | | | | | | |
| Advanced Materials Propeller Research: Integrated Shaft and Propulsor Concept Design Development | | | | ▬▬▬▬▬▬ | | | | | | | | | | | | | | | | | | | | | | | | |

| **Exhibit R-4A**, **RDT&E Schedule Details:** PB 2019 Navy | | **Date:** February 2018 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / *Advanced Submarine System Development* | **Project (Number/Name)**<br>9999 / *Congressional Adds* |

## Schedule Details

| | Start | | End | |
|---|---|---|---|---|
| **Events by Sub Project** | **Quarter** | **Year** | **Quarter** | **Year** |
| *Proj 9999* | | | | |
| Advanced Materials Propeller Research: Advanced Material Propeller Development, Fabrication and Testing | 4 | 2017 | 4 | 2018 |
| Advanced Materials Propeller Research: Advanced Material Propeller Instrumentation and Tool Validation | 4 | 2017 | 4 | 2018 |
| Advanced Materials Propeller Research: Advanced Material Propeller Load Predictions | 4 | 2017 | 4 | 2018 |
| Advanced Materials Propeller Research: Next Generaltion Thrust Concept Development and Testing | 4 | 2017 | 4 | 2018 |
| Advanced Materials Propeller Research: Integrated Shaft and Propulsor Concept Design Development | 4 | 2017 | 4 | 2018 |