| Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Navy | | | | | | | | | | | Date: March 2019 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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* | | | | | | | |
| **COST ($ in Millions)** | **Prior Years** | **FY 2018** | **FY 2019** | **FY 2020 Base** | **FY 2020 OCO** | **FY 2020 Total** | **FY 2021** | **FY 2022** | **FY 2023** | **FY 2024** | **Cost To Complete** | **Total Cost** |
| Total Program Element | 1,029.545 | 91.927 | 105.809 | 148.756 | - | 148.756 | 166.138 | 150.126 | 169.750 | 185.054 | Continuing | Continuing |
| 0223: *Sub Combat System Improvement (ADV)* | 526.594 | 39.648 | 45.898 | 51.151 | - | 51.151 | 53.935 | 55.734 | 57.763 | 58.817 | Continuing | Continuing |
| 2033: *Adv Submarine Systems Development* | 499.151 | 34.513 | 30.615 | 34.857 | - | 34.857 | 27.781 | 26.653 | 23.002 | 23.933 | Continuing | Continuing |
| 2096: *Payload Delivery Development* | 3.800 | 4.738 | 10.969 | 13.936 | - | 13.936 | 12.424 | 10.007 | 13.747 | 14.015 | Continuing | Continuing |
| 3391: *SSN/SSGN Survivability Program* | 0.000 | 8.203 | 8.327 | 10.123 | - | 10.123 | 11.522 | 12.027 | 11.573 | 12.825 | Continuing | Continuing |
| 9710: *Advanced Submarine Technology Development* | 0.000 | 0.000 | 0.000 | 38.689 | - | 38.689 | 60.476 | 45.705 | 63.665 | 75.464 | Continuing | Continuing |
| 9999: *Congressional Adds* | 0.000 | 4.825 | 10.000 | 0.000 | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 14.825 |

**Note**

Project 9710 was previously funded in FY 2019 under Program Element 0604250D8Z (Advanced Innovative Technologies) Project 250 (Advanced Innovative Technologies). This is a Navy new start.

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

The FY 2020 funding request was reduced by $3.000M to account for the availability of prior year execution balances.

This Program Element (PE) 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

| Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Navy | Date: March 2019 |
|---|---|
| **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* |

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 four (4) major efforts: Advanced Processing Builds (APB), Flank Array Demonstration (FAD), Advanced Sensors, and Large Vertical Array (LVA).

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

Flank Array Demonstration (FAD) conducts testing and analysis on the existing Large Vertical Array (LVA) and supports maintenance and correction of identified problems on the array.

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.

Large Vertical Array (LVA) leverages demonstrated FAD developments to conduct critical testing and analysis needed to improve array performance and develop sensor employment tactics. It will introduce new electronic hardware and new software applications to enhance array and signal processing performance. These improvements will be incorporated in future LVA builds for VIRGINIA class SSNs and OHIO and COLUMBIA classes of SSBNs.

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.

| Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Navy | Date: March 2019 |
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| **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 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
- 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 (FMAUV)
- 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

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| **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* |

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: In 2013, OPNAV N97 established SSN/SSGN Survivability Program (S3P) as a separate project area within ASSD to assure SSN/SSGN survivability and the ability of submarines to complete their joint warfighting missions even if covert mobility is compromised. FY18 is the first year of S3P execution as Project 3391 under ASSD with level funding across the FYDP. PBR 19 proposes technology projects that would help pace world-wide technology advances and red investments so as to track and assess US undersea superiority technology insertion plans and their impact on SSN/SSGN survivability.

PROJECT 9710: This program was previously funded in FY 2019 by the Office of the Secretary of Defense (OSD) Strategic Capabilities Office (SCO) under Program Element 0604250D8Z (Advanced Innovative Technologies) Project 250 (Advanced Innovative Technologies) and consists of two (2) sub-projects:

- Project 1
- New Payload Launcher Device (PLD)

Project 1 leverages a separately funded advanced demonstration initiative that launches an existing payload (Payload 1) from U.S. Submarine classes. The payload and ship system integration are managed by separate programs, with further details classified. By leveraging the successful demonstration system, engineering and design work commences rapidly, as it is largely a spiral design upgrade to the demonstration capability and has planning and integration work on which to build. In FY2020 begin initial developmental engineering and design work, award the development contract and conduct the PDR.

In FY2020 a New PLD will be developed to eject payloads out of current submarine ejection systems. The current device lacks the energetic capacity to support the weight and scope of desired larger payloads (Project 1 and others). Rapid development of the new device allows for early integration and testing support for these future payloads, avoiding later costs and redesign of the payload systems. FY2020 efforts include development through preliminary design review (PDR) and critical design review (CDR).

| Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Navy | Date: March 2019 |
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| **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 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| Previous President's Budget | 100.955 | 109.086 | 113.460 | - | 113.460 |
| Current President's Budget | 91.927 | 105.809 | 148.756 | - | 148.756 |
| Total Adjustments | -9.028 | -3.277 | 35.296 | - | 35.296 |
| • Congressional General Reductions | - | -0.070 | | | |
| • Congressional Directed Reductions | - | -13.207 | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | 10.000 | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | -0.300 | 0.000 | | | |
| • SBIR/STTR Transfer | -2.245 | 0.000 | | | |
| • Program Adjustments | 0.000 | 0.000 | 36.291 | - | 36.291 |
| • Rate/Misc Adjustments | 0.000 | 0.000 | -0.995 | - | -0.995 |
| • Congressional General Reductions Adjustments | -0.483 | - | - | - | - |
| • Congressional Directed Reductions Adjustments | -11.000 | - | - | - | - |
| • Congressional Add Adjustments | 5.000 | - | - | - | - |

| Congressional Add Details ($ in Millions, and Includes General Reductions) | FY 2018 | FY 2019 |
|---|---|---|
| **Project:** 9999: *Congressional Adds* | | |
| Congressional Add: *Littoral Water Threats* | 4.825 | 5.000 |
| Congressional Add: *Lightweight Composite Research* | 0.000 | 5.000 |
| Congressional Add Subtotals for Project: 9999 | 4.825 | 10.000 |
| Congressional Add Totals for all Projects | 4.825 | 10.000 |

**Change Summary Explanation**

FUNDING CHANGES AT THE OVERALL PE LEVEL:

- FY 2018 decrease of $-9.028M included: $-0.483M for Congressional General Reductions; $-11.000M for Congressional Directed Reductions; $+5.000M for a Littoral Water Threats Congressional Add; $-0.300M for Reprogramming; and $-2.245M for Small Business Innovative Research (SBIR) transfer.
- FY 2019 decrease of $-3.277M included: $-0.070M for Congressional General Reductions; $-13.207M for Congressional Directed Reductions; $+5.000M for Littoral Water Threats Congressional Add; $+5.000M for Lightweight Composite Research Congressional Add.

- FY 2020 overall increase of $+35.296M included: $+2.000M for Project 0223 Large Vertical Array (LVA); $-3.000M reduction to Project 2033 to account for the availability of prior year execution balances; $+5.688M for realignment of funding into Project 2033; $-8.600M realignment of funding out of Project 2096; $+1.770M for realignment of funding into Project 3391; $+38.689M for realignment of funding into PE for Project 9710; and $-0.995M for various rate adjustments.

PROJECT 0223:

FUNDING: The FY 2019 ($45.898M) to FY 2020 ($51.151M) budget increase ($+5.253M) was driven by the addition of $+2.000M for LVA development, $+3.200M for Advanced Sensor development, and $+1.078M for APB development, with a decrease of $-0.950M for Flank Array Demonstration (FAD). Details on each program's budget increase/decrease from FY 2019 to FY 2020 are as follows:

APB - FY 2019 to FY 2020 increase ($+1.003M) is driven by the initiation of new studies on the use of Machine Learning, Artificial Intelligence (AI), and Big Data Analytics, as required to identify system performance improvements and 3rd Offset (automation) capabilities not currently achievable with legacy technology, develop new automation tools and processing for Unmanned Vehicles and vulnerabilities to CRIKT, and essential to the forward plan for APB-21 to pace emerging threats.

FAD - FY 2019 to FY 2020 decrease ($-0.950M) is in accordance with original program plans. Efforts in FY 2020 will be limited to the maintenance, troubleshooting and repair of faulty or failed array inboard/outboard components.

Advanced Sensors - FY 2019 to FY 2020 increase ($+3.200M) is required for fabrication and testing of a full length Open Architecture Telemetry (OAT) Advanced Development Model (ADM) and testing of active and passive sensor design concept panel for the new Bow Conformal Array (BCA) and initial detailed design efforts. Additional BCA testing is necessary to validate studies conducted in FY 2018 and FY 2019 and to collect data that will be used to improve the acoustic performance of the BCA ADM. BCA ADM detail design will commence in FY 2020.

LVA - New requirement in FY 2020 ($+2.000M). An advanced LVA development program is required to pace the threat of evolutionary quieting of adversary submarines. This effort will begin with at-sea testing and analyses in FY 2020 then ramp up over the FYDP to develop sensor and processing hardware improvements, and signal processing and tactics for each planned submarine platform.

SCHEDULE: APB-19 development and testing was accelerated by six (6) months to accommodate changes in PEO SUB production programs, availability of development facilities, and recent implementation of a conveyor-type development approach. This acceleration will enable a regular every-other year cadence of 1Q at-sea testing and 2Q transition to production for future APBs.

PROJECT 2033:

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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 previously reduced by $2.100 million to account for the availability of prior year execution balances.

The FY 2020 funding request was reduced by $-3.000M to account for the availability of prior year execution balances.

PROJECT 2096:

FY 2018: Congressionally directed program adjustment; Decrease of $11M.

FY 2018 to FY 2019: PHS increased funding 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 increased funding includes component prototype development and testing, and design and engineering team support.

PROJECT 3391:

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

PROJECT 9710:

Project 1 and New Payload Launcher Device (PLD) program was previously funded in FY 2019 by the Office of the Secretary of Defense (OSD) Strategic Capabilities Office (SCO) under Program Element 0604250D8Z (Advanced Innovative Technologies) Project 250 (Advanced Innovative Technologies) ($ +38.689M).

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| 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)* | |

| COST ($ in Millions) | Prior Years | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total | FY 2021 | FY 2022 | FY 2023 | FY 2024 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0223: *Sub Combat System Improvement (ADV)* | 526.594 | 39.648 | 45.898 | 51.151 | - | 51.151 | 53.935 | 55.734 | 57.763 | 58.817 | 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 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). ACB 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 also 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 and Surface systems.

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| ***Title:*** Advanced Processing Build (APB) | 33.873 | 40.773 | 41.776 | 0.000 | 41.776 |
| ***Articles:*** | - | - | - | - | - |
| ***Description:*** APB is a four Step process:<br>Step 1 - algorithm/technology assessment by peer review panels of Subject Matter Experts (SME) to down-select technologies and assist developers with technical guidance.<br>Step 2 - algorithm/technology testing with open and closed data sets to further down-select and refine capabilities prior to integration and testing. | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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)* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| Step 3 - land-based system-level testing stimulated by the Submarine Multi-Mission Team Trainer (SMMTT), in a realistic tactical environment.<br>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-17) and allows for development of longer lead technologies. The content of a specific APB build (every two years on the odd year) is then 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 is performed followed by Steps 3 and 4, as applicable, and transitioned to production.<br><br>***FY 2019 Plans:***<br>- Continue advanced concepts, data collection and analysis for EW APB.<br>- Establish EW APB land-based development environment. Expect to design and procure signal processors, tuners, high speed data recorders, and advanced simulation and simulation 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>- Develop improved EW direction finding, environmental assessment, and detection algorithms. Initiate studies for electronic attack.<br>- Continue development of a Sonar Tactical Decision Aid (STDA) common to submarine, surface, and surveillance applications. Begin to export basic development products to Surface and Surveillance programs.<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>- Collaborate with the Submarine Tactical Requirements Group (STRG) and Information Warfighting Development Center (IWDC) to select candidate imaging, acoustic, tactical control and EW capabilities for APB-21. | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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)* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| - Refine candidate APB-21 capabilities and begin integration into the prior production baseline.<br>***FY 2020 Base Plans:***<br>- Continue refining and integration of candidate capabilities for inclusion in APB-21.<br>- Conduct Step-3 land-based testing of APB-21.<br>- Conduct Step-4 at-sea test of APB-19. Analyze results to inform improvements, tactics and training.<br>- Begin developing and testing new EW capabilities in the land-based development environment established in FY 2019.<br>- Initiate development of electronic attack capabilities.<br>- Continue development of a STDA common to submarine, surface, and surveillance applications. Continue to export development products to Surface programs.<br>- Initiate studies on the use of Machine Learning, Artificial Intelligence (AI), and Big Data Analytics. Seek system performance improvements and 3rd Offset (automation) capabilities not currently achievable with legacy technology.<br>- Continue development of automated technologies specific to CRIKT, targeting particular vulnerabilities.<br>- Continue Step 1 and Step 2 development and testing of concepts, algorithms, and technologies in response to Fleet<br>requirements consistent with the multi-year capability development road map developed in FY 2018.<br>***FY 2020 OCO Plans:***<br>N/A<br>***FY 2019 to FY 2020 Increase/Decrease Statement:***<br>FY 2019 to FY 2020 increase ($+1.003M) is driven by the initiation of new studies on the use of Machine Learning, Artificial Intelligence (AI), and Big Data Analytics, as required to identify system performance improvements and 3rd Offset (automation) capabilities not currently achievable with legacy technology, develop new automation tools and processing for Unmanned Vehicles and vulnerabilities to CRIKT, and essential to the forward plan for APB-21 to pace emerging threats. | | | | | |
| ***Title:*** Flank Array Demonstration (FAD) | 1.975 | 1.325 | 0.375 | 0.000 | 0.375 |
| ***Articles:*** | - | - | - | - | - |
| ***FY 2019 Plans:***<br>- Conduct LVA2 at-sea tests and analyses. Provide on-site support for the maintenance, troubleshooting and repair of faulty or failed array inboard/outboard components. Document troubleshooting and repair findings | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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)* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| for evaluation by engineering team and provide findings/recommendations to the forward and back-fit LVA production programs for Virginia, Ohio and Columbia Class Submarines.<br>***FY 2020 Base Plans:***<br>- Provide on-site support for the maintenance, troubleshooting and repair of faulty or failed array inboard/ outboard components. Document troubleshooting and repair findings for evaluation by engineering team and provide findings/recommendations to the forward and back-fit LVA production programs for Virginia, Ohio and Columbia Class Submarines.<br>***FY 2020 OCO Plans:***<br>N/A<br>***FY 2019 to FY 2020 Increase/Decrease Statement:***<br>- FY 2019 to FY 2020 decrease ($-0.950M) is in accordance with original program plans. Efforts in FY 2020 will be limited to the maintenance, troubleshooting and repair of faulty or failed array inboard/outboard components. | | | | | |
| ***Title:*** Large Vertical Array (LVA)<br>***Articles:***<br>***Description:*** LVA development is a follow-on effort to the exploratory work conducted under the Flank Array Demonstration (FAD) sub-project.<br>***FY 2019 Plans:***<br>N/A<br>***FY 2020 Base Plans:***<br>- Conduct critical at-sea testing events for LVA2 and SSN 790 and analyze at-sea test results. This testing/ analysis is necessary to integrate enhanced signal processing capability for LVAs and to collect data that will be used to improve LVA tactical performance. These processing upgrades are directly applicable to improving the forward and back-fit LVA production programs for Virginia, Ohio and Columbia Class Submarines.<br>***FY 2020 OCO Plans:***<br>N/A<br>***FY 2019 to FY 2020 Increase/Decrease Statement:***<br>- New requirement in FY 2020 ($+2.000M). An advanced LVA development program is required to pace the threat of evolutionary quieting of adversary submarines. This effort will begin with at-sea testing and analysis in | 0.000<br>- | 0.000<br>- | 2.000<br>- | 0.000<br>- | 2.000<br>- |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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)* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| FY 2020 then ramp up over the FYDP to develop sensor and processing hardware improvements, and signal processing and tactics for each planned submarine platform. | | | | | |
| ***Title:*** Advanced Sensors | 3.800 | 3.800 | 7.000 | 0.000 | 7.000 |
| ***Articles:*** | - | - | - | - | - |
| ***FY 2019 Plans:***<br>- Complete Open Architecture Telemetry (OAT) component development, system architecture, and associated ICDs. Conduct array environmental, calibration, and Lake Pend Oreille (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.<br>- Continue development of active and passive sensor concepts to support performance requirements for BCA. Complete test panel design and procurement of material. | | | | | |
| ***FY 2020 Base Plans:***<br>- Complete OAT development, and fabricate a full length OAT array ADM for testing of active and passive sensor design concept panel for the new BCA and initial detailed design efforts at LPO in FY 2021. Additional BCA testing is necessary to validate studies conducted in FY 2018 and FY 2019 and to collect data that will be used to improve the acoustic performance of the BCA ADM.<br>- Complete active and passive studies for BCA. Conduct acoustic test tank and environmental panel testing.<br>- Initiate detailed design of BCA ADM. | | | | | |
| ***FY 2020 OCO Plans:***<br>N/A | | | | | |
| ***FY 2019 to FY 2020 Increase/Decrease Statement:***<br>FY 2019 to FY 2020 increase ($+3.200M) is required for fabrication and testing of a full length Open Architecture Telemetry (OAT) Advanced Development Model (ADM) and testing of active and passive sensor design concept panel for the new Bow Conformal Array (BCA) and initial detailed design efforts. Additional BCA testing is necessary to validate studies conducted in FY 2018 and FY 2019 and to collect data that will be used to improve the acoustic performance of the BCA ADM. BCA ADM detail design will commence in FY 2020. | | | | | |
| **Accomplishments/Planned Programs Subtotals** | 39.648 | 45.898 | 51.151 | 0.000 | 51.151 |

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

N/A

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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)* |

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

**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**

- Construct universal test harness of 13 standard modules with electronics and wire and fiber harnesses for Future Towed Arrays.
- Design and fabricate Next Generation TB-29X hydrophone group design based on results from FY 2017 LPO test.
- Perform initial assessments of future hull array active performance requirements for BCA.
- Begin preliminary test panel design and procure materials in support of FY 2020 BCA testing.
- Support troubleshooting/repair of Large Vertical Array (LVA-2) system on the platform.
- Maintain and procure system inboard and outboard spares for LVA 2.

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| **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 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Product Development | C/CPFF | Adaptive Methods : VA | 1.675 | 0.050 | May 2018 | 0.050 | Dec 2018 | 0.300 | Dec 2019 | - | | 0.300 | Continuing | Continuing | 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 | 1.855 | 0.000 | | 0.125 | Feb 2019 | 0.000 | | - | | 0.000 | 0.000 | 1.980 | Continuing |
| Product Development | C/CPFF | General Dynamics : VA | 24.031 | 0.798 | Feb 2018 | 1.811 | Dec 2018 | 1.992 | Dec 2019 | - | | 1.992 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | GA Tech Research Institute : GA | 3.076 | 0.000 | | 0.080 | May 2019 | 0.385 | Dec 2019 | - | | 0.385 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | In Depth Engineering : VA | 6.335 | 0.750 | Dec 2017 | 0.350 | Dec 2018 | 0.950 | Dec 2019 | - | | 0.950 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | JHU/APL : MD | 101.896 | 9.565 | Nov 2017 | 5.983 | Dec 2018 | 10.500 | Dec 2019 | - | | 10.500 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | Lockheed Martin : VA | 71.290 | 9.034 | Nov 2017 | 10.235 | Dec 2018 | 9.419 | Dec 2019 | - | | 9.419 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | Lockheed Martin : NY | 9.564 | 0.500 | May 2018 | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 10.064 | Continuing |
| Product Development | C/CPFF | Metron : VA | 8.153 | 0.785 | Nov 2017 | 1.300 | Dec 2018 | 0.750 | Dec 2019 | - | | 0.750 | Continuing | Continuing | Continuing |
| Product Development | WR | NSWC/Carderock : MD | 29.834 | 2.008 | Oct 2017 | 2.492 | Nov 2018 | 2.585 | Nov 2019 | - | | 2.585 | Continuing | Continuing | Continuing |
| Product Development | WR | NUWC/Newport : RI | 101.113 | 5.312 | Oct 2017 | 9.176 | Nov 2018 | 9.360 | Nov 2019 | - | | 9.360 | Continuing | Continuing | Continuing |
| Product Development | C/CPAF | NSMA : VA | 12.444 | 0.650 | Jun 2018 | 0.650 | Jan 2019 | 0.650 | Jan 2020 | - | | 0.650 | 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 | 8.274 | 0.278 | May 2018 | 0.244 | Dec 2018 | 0.650 | Dec 2019 | - | | 0.650 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | PSU/ARL : PA | 10.330 | 0.350 | Dec 2017 | 1.133 | Dec 2018 | 0.650 | Dec 2019 | - | | 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 | 13.864 | 1.536 | Jan 2018 | 1.884 | Dec 2018 | 2.000 | Dec 2019 | - | | 2.000 | 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 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| **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 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 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 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 4.595 | Continuing |
| Product Development | MIPR | U.S. Hanscom AFB/ MIT Lincoln Labs : MA | 19.369 | 2.409 | Jan 2018 | 1.820 | Oct 2018 | 2.556 | Dec 2019 | - | | 2.556 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | UT/ARL : TX | 29.584 | 2.347 | Jan 2018 | 1.946 | Dec 2018 | 1.985 | Dec 2019 | - | | 1.985 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | VAR : VAR* | 25.955 | 1.788 | Dec 2017 | 4.869 | Dec 2018 | 4.635 | Dec 2019 | - | | 4.635 | Continuing | Continuing | Continuing |
| | | **Subtotal** | 506.843 | 38.160 | | 44.148 | | 49.367 | | - | | 49.367 | Continuing | Continuing | N/A |

**Remarks**

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

**Management Services ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 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 | 2.000 | 1.400 | Nov 2017 | 1.692 | Nov 2018 | 1.726 | Dec 2019 | - | | 1.726 | Continuing | Continuing | Continuing |
| 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 | 0.795 | 0.088 | Jan 2018 | 0.058 | Nov 2018 | 0.058 | Nov 2019 | - | | 0.058 | Continuing | Continuing | Continuing |
| | | **Subtotal** | 19.751 | 1.488 | | 1.750 | | 1.784 | | - | | 1.784 | Continuing | Continuing | N/A |

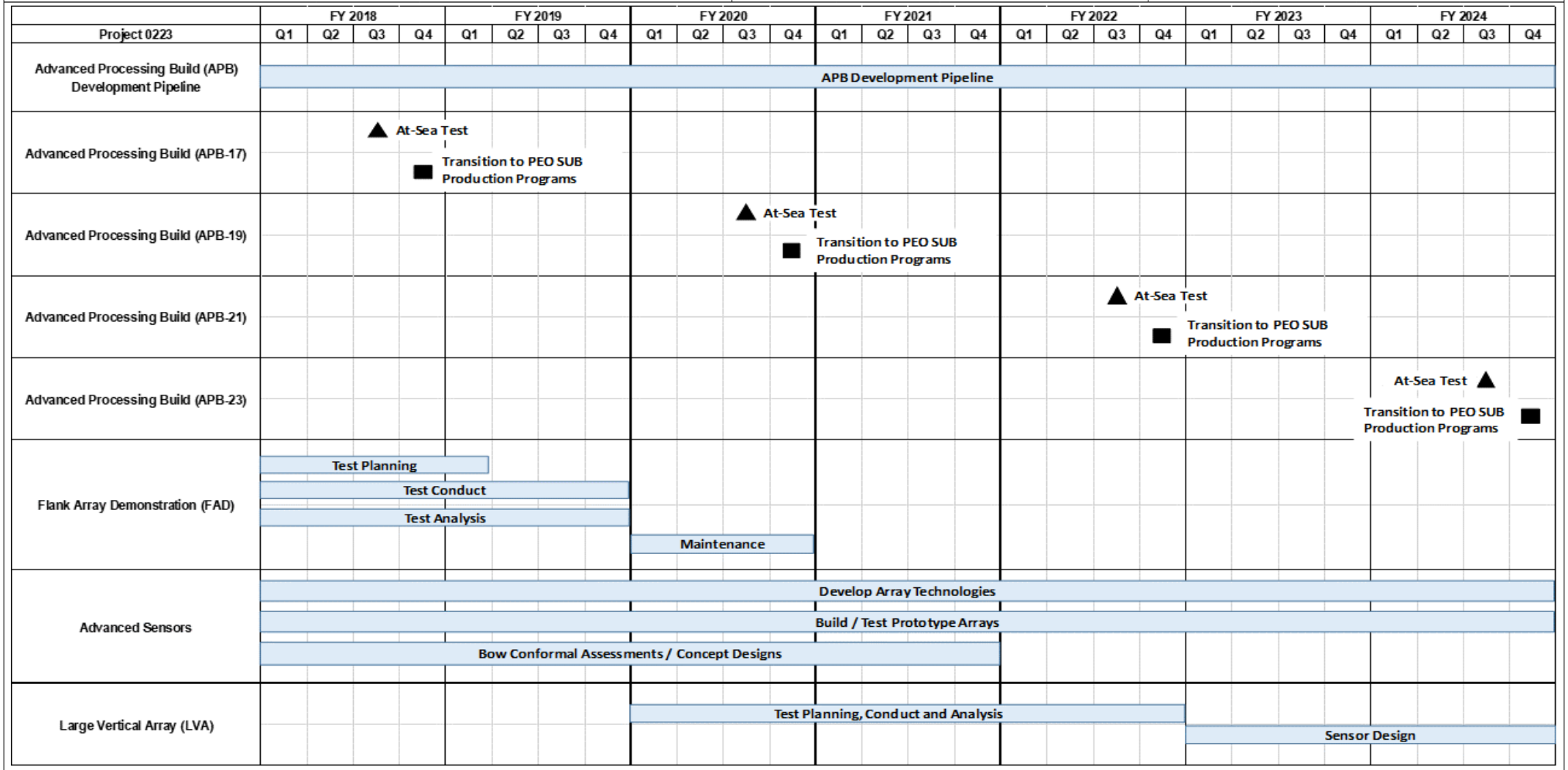
| | Prior Years | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Project Cost Totals** | 526.594 | 39.648 | | 45.898 | | 51.151 | | - | | 51.151 | Continuing | Continuing | N/A |

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| 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)* | |

| | Prior Years | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|

**Remarks**

| Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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)* |



| Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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)* |

## Schedule Details

| | Start | | End | |
|---|---|---|---|---|
| **Events by Sub Project** | **Quarter** | **Year** | **Quarter** | **Year** |
| ***Proj 0223*** | | | | |
| Advanced Processing Build (APB): APB Development Pipeline | 1 | 2018 | 4 | 2024 |
| Advanced Processing Build (APB): APB-17: At-Sea Test | 3 | 2018 | 3 | 2018 |
| Advanced Processing Build (APB): APB-17: Transition to PEO SUB Production Programs | 4 | 2018 | 4 | 2018 |
| Advanced Processing Build (APB): APB-19: At-Sea Test | 3 | 2020 | 3 | 2020 |
| Advanced Processing Build (APB): APB-19: Transition to PEO SUB Production Programs | 4 | 2020 | 4 | 2020 |
| Advanced Processing Build (APB): APB-21: At-Sea Test | 3 | 2022 | 3 | 2022 |
| Advanced Processing Build (APB): APB-21: Transition to PEO SUB Production Programs | 4 | 2022 | 4 | 2022 |
| Advanced Processing Build (APB): APB-23: At-Sea Test | 3 | 2024 | 3 | 2024 |
| Advanced Processing Build (APB): APB-23: Transition to PEO SUB Production Programs | 4 | 2024 | 4 | 2024 |
| Flank Array Demonstration (FAD): Test Planning | 1 | 2018 | 1 | 2019 |
| Flank Array Demonstration (FAD): Test Conduct | 1 | 2018 | 4 | 2019 |
| Flank Array Demonstration (FAD): Test Analysis | 1 | 2018 | 4 | 2019 |
| Flank Array Demonstration (FAD): Maintenance | 1 | 2020 | 4 | 2020 |
| Advanced Sensors: Develop Array Technologies | 1 | 2018 | 4 | 2024 |
| Advanced Sensors: Build / Test Prototype Arrays | 1 | 2018 | 4 | 2024 |
| Advanced Sensors: Bow Conformal Assessments / Concept Designs | 1 | 2018 | 4 | 2021 |
| Large Vertical Array (LVA): Test Planning, Conduct and Analysis | 1 | 2020 | 4 | 2022 |
| Large Vertical Array (LVA): Sensor Design | 1 | 2023 | 4 | 2024 |

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|---|---|---|---|
| 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* | |

| COST ($ in Millions) | Prior Years | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total | FY 2021 | FY 2022 | FY 2023 | FY 2024 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2033: *Adv Submarine Systems Development* | 499.151 | 34.513 | 30.615 | 34.857 | - | 34.857 | 27.781 | 26.653 | 23.002 | 23.933 | Continuing | Continuing |
| Quantity of RDT&E Articles | | - | - | - | - | - | - | - | - | - | | |

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

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

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 infrastructure investments 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 readiness for incorporation into existing and future submarines. 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. Also included in this category are innovative technology transition projects, seedling efforts (<$800K/year) which assess new technology candidates and keep the submarine/ USW technology pipeline primed. All SEA073/ASSD projects are determined by senior USW leadership and N97 sponsor direction.

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 identify and mature technology candidates for integration into current/future submarine classes to provide new/transformational capabilities, while achieving total-ownership cost reductions. Experimentation and demonstration are also conducted in a joint warfighting context with other services, (i.e. Marine Corps, Army, Air Force), to enable early assessment of a 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 Allies such as the United Kingdom and Australia, as well as other international partners, which target core technology maturation, future submarine component concept designs, etc.
Major technology developmental efforts within this budget submission include:

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |

Strategic Capability R&D Infrastructure (at ARD Bayview, ID)
- Large Scale Vehicle (LSV)
- Intermediate Scale Measurement System (ISMS)

Long Range R&D
- Corrosion Control Technologies
- Advanced Submarine Control/Precision Submarine Maneuvering and Control
- Advanced Material Propeller
- Advanced SSN Technologies
- Next Generation Thrust (future propulsor/shafting technologies)
- Advanced Hull Treatments
- Advanced Signature Management

Rapid Technology Development and Submarine Integration
- Common Unmanned Aerial Vehicle (UAS) Communications
- Fleet Modular Autonomous Undersea Vehicle (FMAUV) Mission Capability (Optical Modem for data transfer)
- Li-Ion Battery/SAFECAP for FMAUV Submarine Integration
- Innovative Technology Transfer

The FY 2020 funding request was reduced by $3.000 million to account for the availability of prior year execution balances (IS 68709). Additionally, FY20 reflects an increase in overall budget due to start of the LSV
Electric Drive recapitalization project within the Strategic R&D Infrastructure pillar, and the addition of the associated funding. Funding in other pillars of project 2033 decreased in FY20 due to the planned transition of several Long Range R&D and Rapid Development projects into cognizant acquisition program offices and the realignment/consolidation of several Rapid Development projects. Noteworthy programmatic budget changes in this year's budget exhibits include: (1) (1) Continued focus on Strategic R&D Infrastructure obsolescence reduction
and sustainability, with LSV Steering and Diving System replacement in FY19,continued targeted sparing and time-phased component replacement, and the initiation in FY20 of LSV Electric Drive system design work and supporting
component procurements. (2) Advanced Material Propeller project began its next phase in FY19, will conduct a sea trial aboard an international partner submarine in FY20, followed by post-trial data analysis. (3) The Precision Submarine Maneuvering and Control (PSMC) project proceeds from Trade Study phase into a Concept Development /Refinement phase to identify potential technologies to improve submarine low speed maneuvering in support of emerging missions/payloads. (4) ONR/073 sponsored Corrosion Control focused projects (Advanced Active Shaft Grounding System (AASGS), Shaft Current Sensor (SCS), and shaft grounding Contact Technology (CT)) will test prototypes on a VA Class and transition to PMS 450 in FY19. Ionic Current Monitoring System will also be tested on a VA Class and transition to PMS450. (5) Next Generation Thrust investments continue along several lines of effort, supporting improvements to VA class and future submarine designs for Propulsors and Integrated Shafting components. (6) UAS Comms project transitioned to PMS 425 and 435 in FY19. (7) SAFECAP completed sea trial and qualification process for submarine use of FMAUV Li-Ion battery system, and transitions to PMS 394 in FY20. Other FMAUV projects (Full Mission Capability/Optical Comms) are re-aligned and consolidated under PMS 394 in FY20. (8) Advanced Signature Management project activity will Transition to S3P (project 3391) in FY20. (9) Under C-Wolf

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |

JCTD project transitions to PMW 770 in FY20. (10) Long Range Fiber Buoy and SeaBed Warfare projects paused to assess potential consolidation with other efforts within Undersea Enterprise and optimum project management alignment.

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| ***Title:*** Strategic Capability R&D Infrastructure | 18.046 | 17.976 | 27.590 | 0.000 | 27.590 |
| ***Articles:*** | - | - | - | - | - |
| ***Description:*** Sustains Navy R&D capability for continued operations of the Large Scale Vehicle (LSV-2) and Intermediate Scale Measurement System (ISMS) test facility in support of VIRGINIA and COLUMBIA Class Programs, numerous other smaller programs, and future submarine technology development. These facilities are a critical enabler supporting the conduct of large scale model experiments and focus on evaluating the stealth, control, affordability, and operational effectiveness of new submarine technologies. The technology validation provided by the model experiments has provided significant cost and schedule savings by allowing prototyping at scale, vice with first-of-hull assets. | | | | | |
| ***FY 2019 Plans:***<br>LSV: Continue sub-system technology refresh.<br>Conduct LSV-2 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.<br>Continue critical COLUMBIA propulsor R&D trials, support advanced acoustic array hardware and systems maintenance.<br>Support ship and system alterations to safely conduct COLUMBIA signature and propulsor trials.<br>Install replacement steering and diving actuator system into LSV2.<br>Continue recapitalization planning, component procurement, risk reduction, and sub-system design and development work for LSV-2 electric drive replacement.<br><br>ISMS: Continue ongoing system refurbishment and replacement on ISMS.<br>Operate and maintain ISMS acoustic test range underwater and shore-based facilities.<br>Continue support of structural acoustics, target strength and radiated noise measurements in support of PMS 397, ONR, and other Fleet needs. | | | | | |
| ***FY 2020 Base Plans:***<br>LSV: Support advanced acoustic array hardware and systems maintenance.<br>Replace LSV-2 propulsion battery. | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| Conduct LSV-2 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.<br>Support ship and system alterations to safely conduct COLUMBIA signature and propulsor trials.<br>Complete critical COLUMBIA propulsor R&D trials.<br>Finish design and testing and begin selected procurements of hardware for LSV-2 electric drive replacement.<br><br>Begin LSV-2 recapitalization process: Initiate procurements for shipset of modernized electric drive module components (inverters and converters).<br>Complete system design for Electronic Drive Control Electronics (EDCE) tech refresh and conduct supporting procurement and manufacturing.<br>Conduct component design and initiate procurement for electric drive shaft bearing, flex coupling, and slip ring data transmission system tech refresh.<br>Continue planning for systems integration and testing.<br><br>ISMS: Continue ongoing system refurbishment and replacement on ISMS. Operate and maintain ISMS acoustic test range underwater and shore-based facilities.<br>Continue support of structural acoustics, target strength and radiated noise measurements in support of PMS 397, ONR, and other fleet needs.<br>***FY 2020 OCO Plans:***<br>N/A<br>***FY 2019 to FY 2020 Increase/Decrease Statement:***<br>Increase within the Strategic Infrastructure pillar in FY20 reflects an increase in overall budget due to start of the LSV Electric Drive recapitalization project, and the addition of the associated funding completion of LSV Steering and Diving System Recapitalization project. Minor increase within ISMS expenditures to initiate phased, major component replacement effort. | | | | | |
| ***Title:*** Long Range R&D | 10.399 | 8.282 | 6.909 | 0.000 | 6.909 |
| ***Articles:*** | - | - | - | - | - |
| ***Description:*** Develop advanced technologies and tools to increase current and future submarine capabilities, lower acquisition and life-cycle costs, and enhance survivability. Develop technologies and materials that facilitate new and | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| enhanced existing warfighting concepts. The program currently supports development of advanced submarine hull coatings<br>for improved acoustic performance, maintainability, and cost with the objective of near- term implementation on VA and<br>COLUMBIA Class platforms, as well as future submarine classes. The budget line continues to develop technologies for<br>alternative propulsion designs to enhance submarine performance, maneuverability and stealth while reducing submarine<br>acquisition costs. Lastly, this long-range R&D continues to develop and demonstrate technologies for future submarines<br>in areas of hull and platform technologies, propulsors, propellers, corrosion control, ship control, electric actuation,<br>sensors, and other systems which increase near- term capability and provide cost reduction for in-service and future submarine classes.<br><br>***FY 2019 Plans:***<br>CORROSION CONTROL. Complete Corrosion Control TEMPALT installations for ICMS and AASGS on a VA Class<br>Submarine. Perform at-sea demonstrations of all these TEMPALTS. Complete Improved Damping Tile System (IDTS) lab testing/analysis, develop TEMPALT, install sample on submarine, demonstrate the technology at sea and formally qualify the epoxy material as an alternate formulation for submarine use.<br><br>ADVANCED SUBMARINE CONTROL (ASC). Complete design changes and conduct barge test of the ASC PPM 82 pump jet system. Continue development and testing of ASC technology to assess suitability of a pump-jet for submarine applications.<br><br>PRECISION SUBMARINE MANEUVERING AND CONTROL (PSMC). Conduct trade studies and explore initial set of concepts for PSMC to provide improved slow speed maneuvering capability throughout the water column, in support of emerging missions and payloads.<br><br>ADVANCED MATERIAL PROPELLER (AMP). Complete structural acceptance process for the Advanced Material Propeller (AMP), including fatigue testing of Generation 2 composite blades in partner country, data analysis, and finite element analysis. Complete the structural certification and planning for AMP sea trials. | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| Complete the manufacture and testing of Generation 3 blades and hub, assemble and ship in preparation for at-sea testing. Finalize trial plan priorities and obtain approval from cognizant technical authorities that propeller is acceptable for trial.<br><br>ADVANCED SSN TECHNOLOGIES. Assess advanced technologies and materials for future submarines and perform studies for improved platform capability and performance in support of the Tactical Submarine Evolution Plan (TSEP). Continue support to SEA05U Submarine Concept Team and assess output of Main Storage Battery study<br><br>NEXT GENERATION THRUST. Continue design studies and plan small and/or large scale testing of innovative propulsor and shafting technologies. Continue technology development (classified details) for insertion into VA Block VII. Continue evaluation and design of single propulsor concept utilizing new/non-traditional materials.<br><br>ADVANCED HULL TREATMENTS. Continue industrialization and material assessment to transition advanced coatings technologies from ONR FNC effort. Final tile sizes, coverage and installation methods to be identified through concept designs, with input from NAVSEA shipyard enterprise. Installation planning will include shipping, handling, staging, and application of large tiles during current platform availabilities. Project will also assess material seam configurations and alternate hull paint systems. Finalize industrialization of follow-on ONR advanced treatment, fabrication processes, and down select to a single material candidate to finalize development of a VA Class OPALT package.<br><br>ADVANCED SIGNATURE MANAGEMENT. Initiate advanced signature management demonstrator development and begin supporting planning and TDP/test plan development. Execute US-Partner scale model EM and full- scale acoustic trails at US range, conduct data analysis and begin TDP development for downstream insertion of technology into VA Class. Transition Advanced Signature Management project activity to S3P (project 3391).<br><br>RELIABLE TOWED ARRAY. Transition Reliable Towed Array Project to PMS 401 for at-sea testing with VA Class to validate software model performance data. Instrumented array to be subsequently used by PMS401/ NUWC to inform future thin-line towed array design, development and acquisition. | | | | | |
| ***FY 2020 Base Plans:*** | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| ADVANCED SUBMARINE CONTROL (ASC). Conduct analysis of barge test and complete additional system design changes. Perform an in-water system operational pressure test. Continue assessment of ASC/pump-jet technology suitability for submarine applications.<br><br>PRECISION SUBMARINE MANEUVERING AND CONTROL (PSMC). Further develop PSMC concepts. Down-select based on feasibility, initiate preliminary design, and identify required modeling/simulation tool development in support of performance characterization.<br><br>AMP. Install and test full-scale AMP propeller on partner submarine and conduct at-sea trial/data collection. Initiate follow-on Project Arrangement for destructive testing and analysis of full-scale propeller data.<br><br>ADVANCED HULL TREATMENTS. Complete the industrialization of the ONR advanced treatment and perform testing necessary to increase TRL. Complete OPALT and associated technical data package for installation of the ONR advanced treatment test patches on a VA class submarine. Finalize installation approaches with Portsmouth Naval Shipyard and provide installation procedures to shipyard to develop necessary work packages. Perform installation mockup in support of test patch installation.<br><br>NEXT GENERATION THRUST. Further develop most promising NGT concepts and initiate design tool improvement initiatives.<br><br>ADVANCED SSN TECHNOLOGIES. Continue assessment of new technologies for future submarines in support of the Tactical Submarine Evolution Plan (TSEP) and conduct studies to assess potential impacts on platform capability. Identify enabling technologies and platform integration barriers. Initiate development on critical, long-lead technologies/materials.<br><br>***FY 2020 OCO Plans:***<br>N/A<br><br>***FY 2019 to FY 2020 Increase/Decrease Statement:***<br>Decrease within Long Range R & D pillar reflects Transition of Advanced Signature Management project into S3P (Project 3391) and transition of SADS/ITDS FNC to PMS 450. | | | | | |
| ***Title:*** Rapid Technology Development and Submarine Integration | 6.068 | 4.357 | 0.358 | 0.000 | 0.358 |
| ***Articles:*** | - | - | - | - | - |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| ***Description:*** Conducts Navy and joint demonstrations of advanced technologies and payloads to assess the operational value of the technologies/systems under consideration, and speed transition of operational capabilities. Objective is to develop, demonstrate, and evaluate technology projects in an 18-30 month period, transitioning successful, high-interest / high-impact systems to the acquisition community and subsequently the fleet.<br><br>***FY 2019 Plans:***<br>FMAUV LITHIUM ION BATTERY CERTIFICATION/SAFECAP. Complete SAFECAP test article fabrication, Battery Casualty Detection System (BCDS) build, and shock testing. Conduct capstone, shore-based battery test. Continue TEMPALT development. Transition SAFECAP to PMS 394 for subsequent at-sea testing in FY20.<br><br>FMAUV FULL MISSION CAPABILTY. Continue FMAUV Optical Modem development and testing. Transition project to PMS 394 for subsequent at-sea testing in FY20.<br><br>JOINT CONCEPT TEST DEMONSTRATION (JCTD). Continue planning for follow-on FMAUV Optical Modem demonstration/testing during Under C-WOLF JCTD. Transition Under C-Wolf JCTD project to PMW 770 for FY20 execution.<br><br>INNOVATIVE TECHNOLOGY TRANSITION. Continued to leverage products and analysis from Small Business (SBIR/STTR), Independent Research and Development (IR&D), and Foreign Comparative Testing efforts to identify/develop innovative submarine and USW technology transition project candidates. FY19 projects include Shaft Laser Peening (Corrosion Control), Undersea Target Recognition (international project arrangement follow-on to LCAC), Towed Array Signal Path (System Reliability Improvement),Special Hull Treatment (SHT) Delamination Detection (detection tools), and Composite Canister System (Payload flexibility).<br><br>***FY 2020 Base Plans:***<br>INNOVATIVE TECHNOLOGY TRANSITION. Continued to leverage products and analysis from Small Business (SBIR/STTR), Independent Research and Development (IR&D), and Foreign Comparative Testing efforts to identify/develop innovative submarine and USW technology transition project candidates. FY20 planned projects include Shaft Laser Peening (Corrosion Control), and Undersea Target Recognition (International | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| Project Arrangement follow-on to LCAC), Special Hull Treatment (SHT) Delamination Detection (detection tools), and Composite Canister System (Payload flexibility).<br>***FY 2020 OCO Plans:***<br>N/A<br>***FY 2019 to FY 2020 Increase/Decrease Statement:***<br>Reduction within Rapid Development due to completion of SAFECAP sea trial, realignment of FMAUV projects to PMS394 and realignment of Under C-wolf JCTD to PMW 770. | | | | | |
| **Accomplishments/Planned Programs Subtotals** | 34.513 | 30.615 | 34.857 | 0.000 | 34.857 |

**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) Newport News Shipbuilding facilitate this process. Use of topic-specific Broad Agency 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 Hull Mechanical & Electrical (HM&E) technology and payload systems. For the period from FY 18- FY 20,073 is utilizing two separate Determination and Findings (D&F's), one with Sandia National Labs to design, build, integrate, and test Battery Casualty Detection Systems (BCDS) and one with Oak Ridge National Laboratory (ORNL) to explore advanced transition technologies relevant to submarine applications for the Navy.

**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 evaluate 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 an advanced demonstrator.
-Successfully construct and deliver full-scale advanced material propeller for at-sea testing.
-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 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| 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* | |

**Product Development ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Product Development | C/FFP | DRS Technologies : Milwaukee, WI | 0.000 | 0.000 | Nov 2018 | 1.000 | Apr 2019 | 6.873 | Jan 2020 | - | | 6.873 | 0.000 | 7.873 | - |
| Product Development | C/FFP | Moog : East Aurora, NY | 0.000 | 0.900 | Aug 2018 | 0.400 | Aug 2019 | 0.000 | | - | | 0.000 | 0.000 | 1.300 | - |
| Product Development | C/CPFF | Seeman Composite : Gulfport, MS | 0.000 | 0.000 | Sep 2018 | 0.200 | Sep 2019 | 0.000 | | - | | 0.000 | 0.000 | 0.200 | - |
| Product Development | WR | NSWC Crane : Crane, IN | 0.000 | 0.440 | Nov 2018 | 0.200 | Nov 2019 | 0.000 | | - | | 0.000 | 0.000 | 0.640 | - |
| Product Development | C/CPFF | Rolls Royce marine : Walpole, MA | 0.000 | 0.000 | Sep 2018 | 0.100 | Sep 2019 | 0.100 | Sep 2020 | - | | 0.100 | 0.000 | 0.200 | - |
| Product Development | WR | NSWC PHILLY : Philly, PA | 0.165 | 0.000 | Nov 2018 | 0.275 | Nov 2019 | 0.275 | Nov 2019 | - | | 0.275 | Continuing | Continuing | Continuing |
| Product Development | WR | NRL : Washington, DC | 2.318 | 0.389 | Nov 2018 | 0.300 | Nov 2019 | 0.000 | | - | | 0.000 | 0.000 | 3.007 | - |
| 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 | 13.510 | 3.554 | Apr 2018 | 3.000 | Apr 2019 | 3.150 | Apr 2020 | - | | 3.150 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | EB : Groton, CT | 74.785 | 2.901 | Apr 2018 | 3.108 | Apr 2019 | 6.030 | Apr 2020 | - | | 6.030 | Continuing | Continuing | Continuing |
| Product Development | WR | NSWC : Carderock, MD | 94.918 | 4.825 | Apr 2018 | 2.730 | Apr 2019 | 3.185 | Apr 2020 | - | | 3.185 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | ARL/PSU : State College, PA | 9.003 | 0.965 | Apr 2018 | 0.585 | Apr 2019 | 0.597 | Apr 2020 | - | | 0.597 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | JHU/APL : Laurel, MD | 23.197 | 1.224 | Apr 2018 | 0.250 | Apr 2019 | 0.250 | Apr 2020 | - | | 0.250 | Continuing | Continuing | Continuing |
| Product Development | Various | Various : Various | 36.210 | 0.290 | Apr 2018 | 0.296 | Apr 2019 | 0.302 | Apr 2020 | - | | 0.302 | Continuing | Continuing | Continuing |
| Product Development | WR | NUWC : Newport, RI | 77.953 | 1.025 | Mar 2018 | 1.830 | Mar 2019 | 1.000 | Mar 2020 | - | | 1.000 | 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 | May 2019 | 0.000 | | - | | 0.000 | 0.000 | 0.695 | - |
| | | **Subtotal** | 345.936 | 16.513 | | 14.274 | | 21.762 | | - | | 21.762 | Continuing | Continuing | N/A |

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| 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* | |

**Product Development ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**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.

**Support ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Contractor Engineering Support | SS/CPFF | Various : Various | 14.956 | 1.340 | Jun 2018 | 1.350 | Mar 2019 | 1.000 | Mar 2020 | - | | 1.000 | Continuing | Continuing | Continuing |
| Government Engineering Support | WR | Various : Various | 7.213 | 0.357 | Mar 2018 | 0.364 | Mar 2019 | 0.371 | Mar 2020 | - | | 0.371 | Continuing | Continuing | Continuing |
| Travel | WR | NAVSEA HQ : Not Specified | 1.103 | 0.102 | Mar 2018 | 0.104 | Mar 2019 | 0.106 | Mar 2020 | - | | 0.106 | Continuing | Continuing | Continuing |
| Acquisition Workforce | Various | Not Specified : Not Specified | 0.293 | 0.000 | | 0.000 | Nov 2018 | 0.000 | | - | | 0.000 | 0.000 | 0.293 | 0.293 |
| | | **Subtotal** | 23.565 | 1.799 | | 1.818 | | 1.477 | | - | | 1.477 | 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 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Developmental Test & Evaluation | C/CPFF | GD IT : Bayview, ID | 0.000 | 1.600 | Aug 2018 | 1.600 | Aug 2019 | 1.000 | Aug 2020 | - | | 1.000 | 0.000 | 4.200 | - |
| Developmental Test & Evaluation | SS/CPFF | EB : Groton, CT | 19.498 | 5.810 | May 2018 | 5.820 | May 2019 | 4.916 | May 2020 | - | | 4.916 | Continuing | Continuing | Continuing |
| Developmental Test & Evaluation | WR | NSWC/PHILLY : PHILLY, PA | 9.104 | 0.240 | Dec 2017 | 0.240 | Dec 2018 | 0.240 | Dec 2019 | - | | 0.240 | 0.000 | 9.824 | 9.104 |

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| 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 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Developmental Test & Evaluation | Various | Various : Various | 8.057 | 0.675 | Apr 2018 | 0.675 | Apr 2019 | 0.689 | Apr 2020 | - | | 0.689 | 0.000 | 10.096 | 6.372 |
| Developmental Test & Evaluation | WR | NUWC : Newport, RI | 29.910 | 1.255 | Apr 2018 | 1.050 | Apr 2019 | 0.500 | Apr 2020 | - | | 0.500 | Continuing | Continuing | Continuing |
| Developmental Test & Evaluation | WR | NSWC : Carderock, MD | 50.637 | 4.621 | Apr 2018 | 5.138 | Apr 2019 | 4.273 | Apr 2020 | - | | 4.273 | Continuing | Continuing | Continuing |
| Developmental Test & Evaluation | SS/CPFF | HII : Newport News, VA | 5.794 | 0.000 | | 0.000 | Oct 2018 | 0.000 | Oct 2019 | - | | 0.000 | Continuing | Continuing | Continuing |
| Developmental Test & Evaluation | SS/CPFF | JHU/ARL : Laurel, MD | 5.805 | 2.000 | Apr 2018 | 0.000 | Apr 2019 | 0.000 | | - | | 0.000 | 0.000 | 7.805 | 0.305 |
| Developmental Test & Evaluation | SS/CPFF | ARL/PSU : State College, PA | 0.845 | 0.000 | | 0.000 | Oct 2018 | 0.000 | | - | | 0.000 | 0.000 | 0.845 | 0.720 |
| | | **Subtotal** | 129.650 | 16.201 | | 14.523 | | 11.618 | | - | | 11.618 | Continuing | Continuing | N/A |

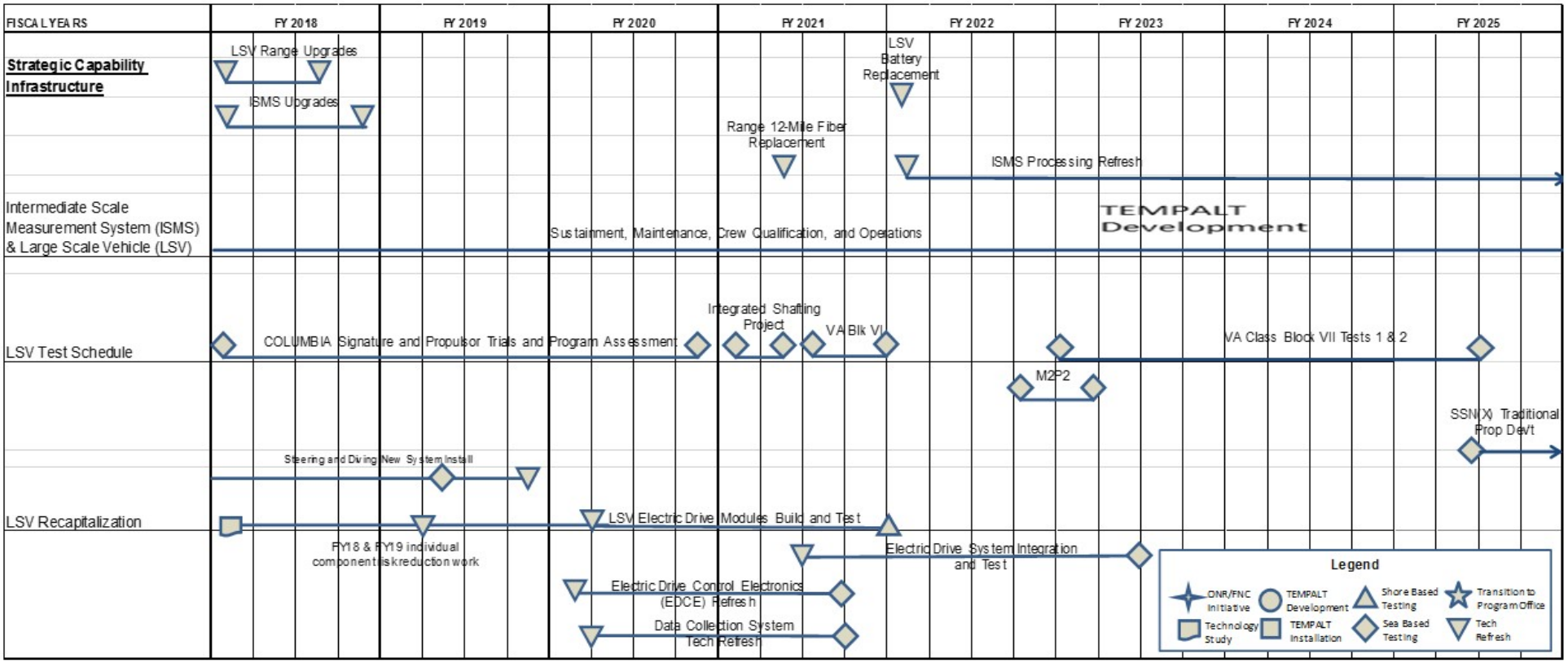
**Remarks**

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.

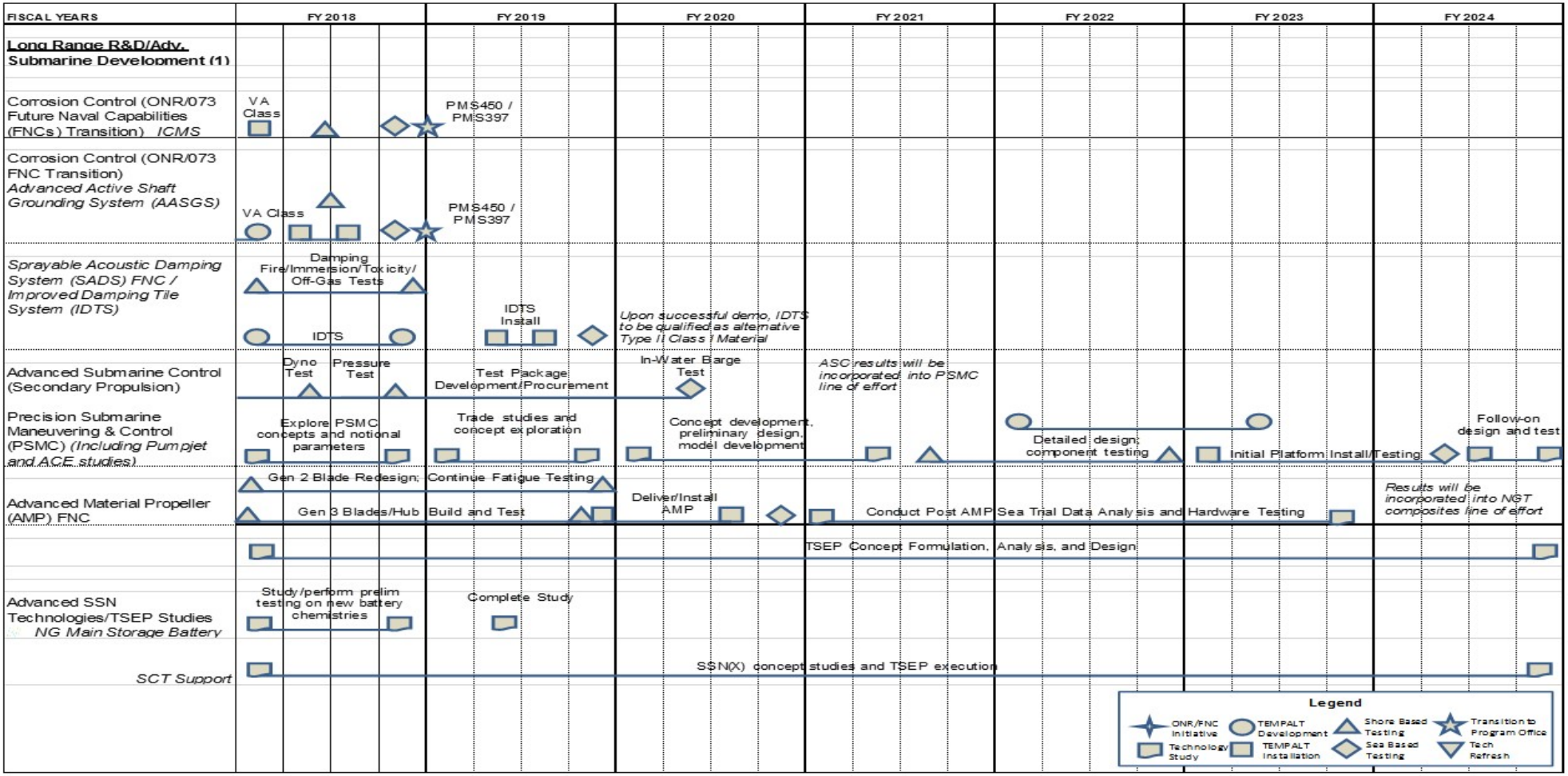
| | Prior Years | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Project Cost Totals** | 499.151 | 34.513 | | 30.615 | | 34.857 | | - | | 34.857 | Continuing | Continuing | N/A |

**Remarks**

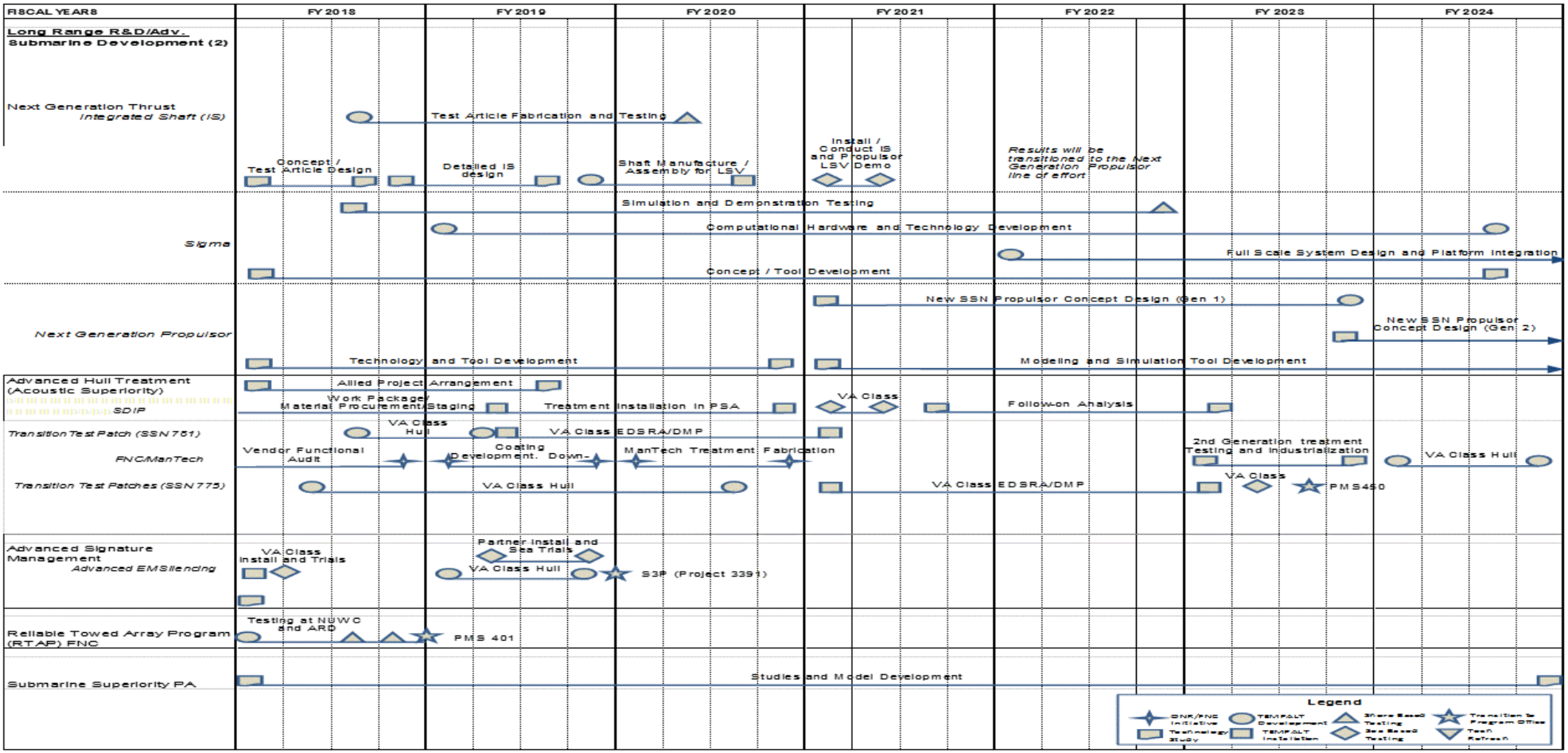
| Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / *Advanced Submarine System Development* | **Project (Number/Name)**<br>2033 / *Adv Submarine Systems Development* |



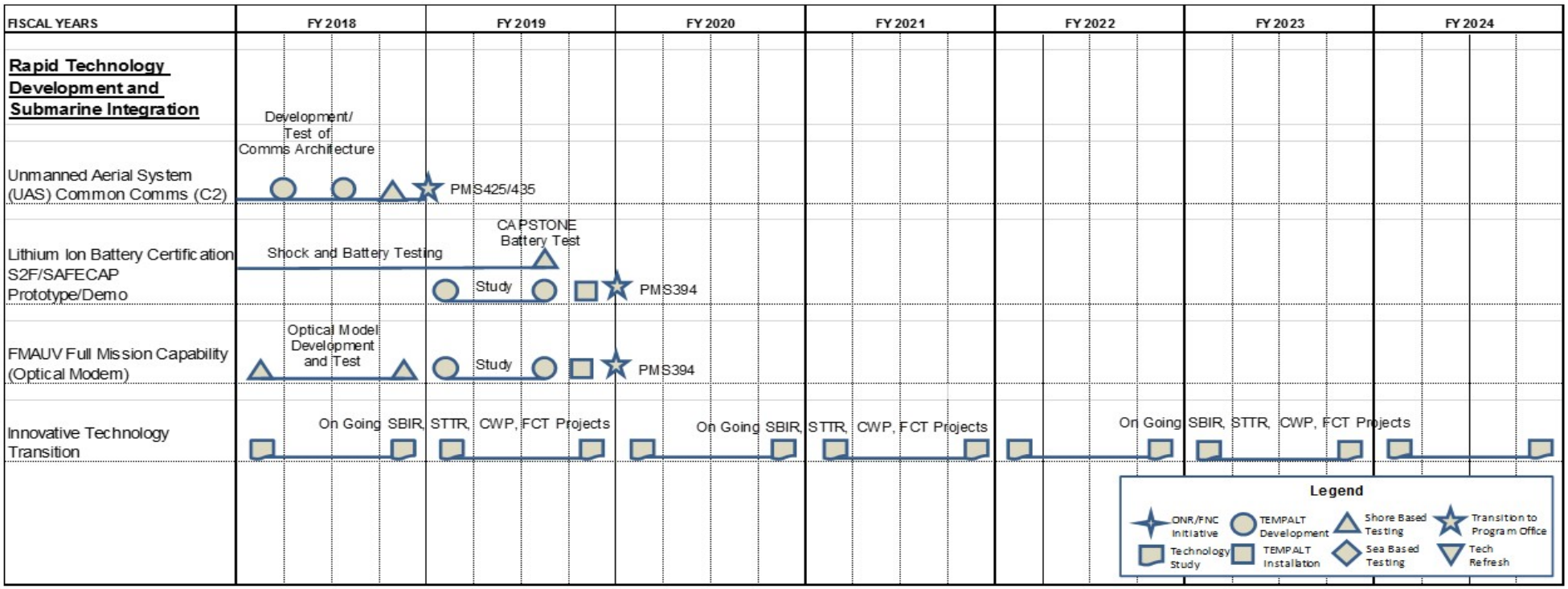
| Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / *Advanced Submarine System Development* | **Project (Number/Name)**<br>2033 / *Adv Submarine Systems Development* |



| Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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-4, RDT&E Schedule Profile: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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 Details

| | Start | | End | |
|---|---|---|---|---|
| **Events by Sub Project** | **Quarter** | **Year** | **Quarter** | **Year** |
| ***Proj 2033*** | | | | |
| Strategic Capability Infrastructure: LSV Test Schedule - Range Upgrade for LSV | 1 | 2018 | 3 | 2018 |
| Strategic Capability Infrastructure: ISMS/LSV - ISMS Upgrades | 1 | 2018 | 4 | 2018 |
| 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 | 2024 |
| Strategic Capability Infrastructure: ISMS /LSV - Sustainment, Maintenance,Crew Qualification and Operations | 1 | 2018 | 4 | 2024 |
| Strategic Capability Infrastructure: ISMS /LSV - Battery Replacement | 3 | 2020 | 3 | 2020 |
| Strategic Capability Infrastructure: LSV Test Schedule - COLUMBIA Propulsor Testing | 1 | 2018 | 4 | 2020 |
| Strategic Capability Infrastructure: LSV Test Schedule - Integrated Shafting | 1 | 2021 | 2 | 2021 |
| Strategic Capability Infrastructure: LSV Test Schedule - VA Block VI | 3 | 2021 | 4 | 2021 |
| Strategic Capability Infrastructure: LSV Test Schedule - VA Block VII | 1 | 2023 | 4 | 2024 |
| Strategic Capability Infrastructure: LSV Test Schedule - M2P2 | 4 | 2022 | 1 | 2023 |
| Strategic Capability Infrastructure: LSV Test Schedule - LSV Steering and Diving Replacement | 1 | 2018 | 4 | 2019 |
| Strategic Capability Infrastructure: LSV Recapitalization - FY18-19 Risk Reduction Tasking & Component Procurement/Build | 1 | 2018 | 4 | 2019 |
| Strategic Capability Infrastructure: LSV Recapitalization - Electric Drive Models Build/ Test | 2 | 2020 | 4 | 2021 |
| Strategic Capability Infrastructure: LSV Recapitalization - Electric Drive System | 2 | 2021 | 2 | 2023 |
| Strategic Capability Infrastructure: LSV Recapitalization - EDCE Refresh | 1 | 2020 | 3 | 2020 |

| Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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** |
| Strategic Capability Infrastructure: LSV Recapitalization - Data Collection System Refresh | 2 | 2020 | 4 | 2021 |
| Long Range R&D/Advanced Submarine Development: Corrosion Control - ICMS - Perform shore-based testing and initial shipboard testing. Transition to PMS450 for EM Trial execution | 1 | 2018 | 1 | 2019 |
| Long Range R&D/Advanced Submarine Development: Corrosion Control - AASGS - Install SCS and CT TEMPALTs. Conduct shore-based and initial shipboard testing. | 1 | 2018 | 1 | 2019 |
| Long Range R&D/Advanced Submarine Development: Corrosion Control - AASGS - Transition to PMS 450 for at-sea EM trial execution. | 4 | 2018 | 2 | 2019 |
| Long Range R&D/Advanced Submarine Development: SADS/IDTS - Complete in-lab comparative testing of the legacy & IDTS tiles | 1 | 2018 | 2 | 2019 |
| Long Range R&D/Advanced Submarine Development: SADS/IDTS - Conduct TEMPALT install, shipboard at-sea testing and performance analysis | 3 | 2019 | 1 | 2020 |
| Long Range R&D/Advanced Submarine Development: Advanced Submarine Control - (ASC) - Conduct dynamometer and design improvement changes | 1 | 2018 | 4 | 2018 |
| Long Range R&D/Advanced Submarine Development: Advanced Submarine Control - (ASC) - Conduct in-water barge test and operational pressure test | 2 | 2019 | 1 | 2020 |
| Long Range R&D/Advanced Submarine Development: Advanced Submarine Control - (ASC) - Data analysis and suitability assessment | 1 | 2020 | 4 | 2020 |
| Long Range R&D/Advanced Submarine Development: Precision Submarine Maneuvering and Control (PSMC) - Explore PSMC capability space and relevant parameters | 1 | 2018 | 4 | 2018 |
| Long Range R&D/Advanced Submarine Development: Precision Submarine Maneuvering and Control (PSMC) - Conduct Trade Studies and Concept Exploration | 1 | 2019 | 4 | 2019 |
| Long Range R&D/Advanced Submarine Development: Precision Submarine Maneuvering and Control (PSMC) - Concept development, prelim design and model development. | 1 | 2020 | 2 | 2021 |
| Long Range R&D/Advanced Submarine Development: Precision Submarine Maneuvering and Control (PSMC) - Conduct component detailed design and testing. | 3 | 2021 | 4 | 2022 |

| Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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: Precision Submarine Maneuvering and Control (PSMC) - Conduct Initial Platform Introductions and testing | 1 | 2023 | 2 | 2024 |
| Long Range R&D/Advanced Submarine Development: Advanced Material Propeller - Redesign manufacture and fatigue test Mod Gen 2 blade | 1 | 2018 | 4 | 2019 |
| Long Range R&D/Advanced Submarine Development: Advanced Material Propeller - Manufacture and test Gen 3 blades and hub | 1 | 2018 | 4 | 2019 |
| Long Range R&D/Advanced Submarine Development: Advanced Material Propeller (AMP) - Deliver and install AMP propeller | 4 | 2019 | 3 | 2020 |
| Long Range R&D/Advanced Submarine Development: Advanced Material Propeller (AMP) - At-sea test on partner submarine | 4 | 2020 | 4 | 2020 |
| Long Range R&D/Advanced Submarine Development: Advanced Material Propeller (AMP) - Post-sea trial data analysis and hardware testing | 1 | 2021 | 4 | 2023 |
| Long Range R&D/Advanced Submarine Development: SSN(X) - Advanced SSN Technologies/TSEP Studies - TSEP concept formulation, analysis, and design | 1 | 2018 | 4 | 2024 |
| Long Range R&D/Advanced Submarine Development: Next Generation Thrust (NGT) - Concept /Test Article design | 1 | 2018 | 3 | 2018 |
| Long Range R&D/Advanced Submarine Development: Advanced Hull Coatings - Allied Project Arrangement Coating Development and Modeling | 1 | 2018 | 3 | 2019 |
| Long Range R&D/Advanced Submarine Development: Advanced Hull Coatings - Develop SDIP OPALT work package, conduct advanced procurement and material staging. | 1 | 2018 | 2 | 2019 |
| Long Range R&D/Advanced Submarine Development: Advanced Hull Coatings - Conduct SDIP OPALT installation follow on at-sea testing and analysis | 2 | 2019 | 4 | 2022 |
| Long Range R&D/Advanced Submarine Development: Advanced Hull Coatings - Conduct development, down-selection and collaborative MANTECH industrialization of NG treatment with ONR | 1 | 2018 | 3 | 2020 |
| Long Range R&D/Advanced Submarine Development: Advanced Hull Coatings - Develop, install and test NG treatment OPALT on VA class and transition to PMS450 | 2 | 2018 | 1 | 2023 |

| Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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: Advanced Signature Management Conduct TEMPALT development planning/execution in support of US trials & bi-lateral Adv EM Silencing Project Arrang | 1 | 2018 | 4 | 2019 |
| Long Range R&D/Advanced Submarine Development: Reliable Towed Array Program - Develop software tools & prototype instrumented array to predict operational loading. Transition to PMS401 | 1 | 2018 | 4 | 2018 |
| Long Range R&D/Advanced Submarine Development: Submarine Superiority Project Arrangement - Conduct studies and model development | 1 | 2018 | 4 | 2024 |
| Rapid Technology Development and Submarine Integration: Common Unmanned Aerial System (UAS) Comms. Antenna development and comm architecture testing. Transition to PMS 425/435 | 1 | 2018 | 4 | 2018 |
| Rapid Technology Development and Submarine Integration: Lithium Ion Battery Certification/SAFECAP - Complete shore-based testing, develop TEMPALT, and execute at-sea test. Transition to PMS394. | 1 | 2018 | 4 | 2019 |
| Rapid Technology Development and Submarine Integration: FMAUV Full Mission Capability - Dev optical modem for data transfer, dev TEMPALT, execute demo with SAFECAP. Transition to PMS394 | 1 | 2018 | 4 | 2019 |
| Rapid Technology Development and Submarine Integration: Innovative Technology Transition - Conduct assessment of technology initiatives, SBIR transition work & foreign comparative tests | 1 | 2018 | 4 | 2024 |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| 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* | |

| COST ($ in Millions) | Prior Years | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total | FY 2021 | FY 2022 | FY 2023 | FY 2024 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2096: *Payload Delivery Development* | 3.800 | 4.738 | 10.969 | 13.936 | - | 13.936 | 12.424 | 10.007 | 13.747 | 14.015 | Continuing | Continuing |
| Quantity of RDT&E Articles | | - | - | - | - | - | - | - | - | - | | |

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

Payload Delivery Development is a non-acquisition program used for the integration of large deployable and retrievable payloads with submarines. RDT&EN funding will be used to design, manufacture, and field a prototype payload launch and recovery system utilized with submarine large ocean interfaces to accommodate large diameter payloads and offboard systems. The project enables launch and recovery of these systems from submarines. This will provide the Submarine Force with the capability to launch and recover large payloads and offboard systems of various configurations in support of critical Undersea Warfare (USW) missions, providing battle space awareness and extending war-fighting reach. This capability has been identified as a key enabler for the following critical USW mission areas: Intelligence, Surveillance, and Reconnaissance (ISR), Anti-Submarine Warfare (ASW), Anti-Surface Warfare (ASUW), Naval Special Warfare (NSW), Mine Warfare, Seabed Warfare, Counter- Autonomous Underwater Vehicle (AUV) Warfare, Electromagnetic Maneuver Warfare (EMMW), Deception, and Non-Lethal Sea Control. This capability is paramount to countering anti-access/area denial (A2/AD) threats from emerging world powers and maintaining dominance in the undersea domain. 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.

Current controls reflect the termination of SL-UKAS by the Navy in FY19 and subsequent funding reduction.

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| ***Title:*** Payload Handling System (PHS) | 4.688 | 10.969 | 13.936 | 0.000 | 13.936 |
| ***Articles:*** | - | - | - | - | - |
| ***Description:*** PHS includes the development, integration and demonstration of a single prototype "middle-ware" handling system used to deploy and retrieve large undersea vehicles, payloads, and offboard systems from submarines. Funding will be used to design, manufacture, and field a prototype to facilitate the raising, lowering and articulation of payloads into and out of submarine large ocean interfaces (e.g. missile tubes) to increase war fighting capabilities. PHS will initially be integrated and demonstrated on an SSGN platform to foster and assess early technology (vertical stowage, launch and recovery capability) integration and operational concept/ employment. Subsequently, PHS includes efforts to transfer the technology and final design to industry for future multi-unit procurement and application on future VIRGINIA Class and other submarines. | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| Payloads currently planned for vertical launch, recovery, and stowage include the U.S. Navy's Family of Unmanned Systems up to large size (e.g. SNAKEHEAD) and future block of Shallow Water Combat Submersibles (SWCS) to support Special Operations Forces (SOF) capabilities. The modularity of hosting these payloads within a tube loaded canister allows for the PHS and/or payload(s) to be swapped out with other payloads (e.g. missiles) while forward deployed dependent upon mission tasking of the submarine.<br><br>Increased funding from FY18 to FY19 is required to maintain schedule for increased Non-Recurring Engineering (NRE) demand associated with Initial Design Review (IDR) and Final Design Review (FDR); including risk reducing component prototype development/testing and material/hardware identification and sourcing. Long lead- time material purchases begin in FY19 and continue into FY20. Planned FY20 efforts include completion of detailed analysis and design for subsystem elements, interface control documentation, drawings, and material purchases.<br><br>***FY 2019 Plans:***<br>Continue NRE to conduct Initial Design Review (IDR), commence detail design efforts including drawing & specification development, and refine material identification & sourcing and initiate purchases.<br><br>Specific FY19 tasks required for FY20 Final Design Review (FDR) are as follows:<br>- Continue refining System Arrangements, Structural and Shock Modeling Analyses, and Interface Control Document<br>- Continue material research and risk reduction fabrication<br>- Assess fabrication risk<br>- Identify material/hardware to support material purchase<br>- Identify material sourcing (price & availability)<br>- Power Distribution Element (PDE) design development<br>- Hydraulic System Element (HSE) design development<br>- Control & Monitoring Element (CME) design development<br>- Payload Handling Element (PHE) design development<br>- System Schematic and Diagram Development<br>- Complete PHE EDR<br>- Complete Initial Design Review (IDR)<br>- Fabrication Cost Estimate development | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| - Fabrication and Build Strategy development<br>- Commence Long Lead Time and Other Material Sourcing and Purchasing<br><br>***FY 2020 Base Plans:***<br>Continue NRE to conduct Final Design Review (FDR), complete detail design efforts and Technical Data Package<br>(TDP) review and approval, execute material purchases.<br><br>- Continue refining System Arrangements, Structural and Shock Modeling Analyses, and Interface Control Document<br>- Power Distribution Element (PDE) design completion<br>- Hydraulic System Element (HSE) design completion<br>- Control & Monitoring Element (CME) design completion<br>- Payload Handling Element (PHE) design completion<br>- System Schematic and Diagram Development<br>- Conduct FDR<br>- Continue Long Lead Time and other material sourcing and purchasing<br>- Conduct Fabrication Readiness Review (FRR)<br>- Start prototype fabrication and assembly<br><br>***FY 2020 OCO Plans:***<br>N/A<br><br>***FY 2019 to FY 2020 Increase/Decrease Statement:***<br>Increase in FY20 budget is required to complete system element designs, conduct a Final Design Review (FDR) and purchase material in conjunction with starting system fabrication. | | | | | |
| ***Title:*** 3 Inch Submarine Launched Unmanned K Aerial System | 0.050 | 0.000 | 0.000 | 0.000 | 0.000 |
| ***Articles:*** | - | - | - | - | - |
| ***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, and testing 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 integrated and tested at a land based facility by the end of FY19. Technical Data Packages will transition to the Submarine Combat Control System Program Office (PMS 425) at the end of FY19. | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| 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:<br><br>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.<br>2. Testing necessary to prove out the capability and define CONOPs.<br>3. Development/testing "safe arm mechanism" to safely stow proposed equipment types onboard submarines.<br><br>***FY 2019 Plans:***<br>The Navy terminated the SL-UKAS program in FY 19. This reduction is reflected in the current controls.<br><br>***FY 2020 Base Plans:***<br>The Navy terminated the SL-UKAS program in FY 19 and out years. This reduction is reflected in the current controls.<br><br>***FY 2020 OCO Plans:***<br>N/A<br><br>***FY 2019 to FY 2020 Increase/Decrease Statement:***<br>Decreased funding in FY20 reflects the termination of SL-UKAS in FY19. | | | | | |
| **Accomplishments/Planned Programs Subtotals** | 4.738 | 10.969 | 13.936 | 0.000 | 13.936 |

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

N/A

**Remarks**

**D. Acquisition Strategy**

Project will transition to VIRGINIA class with VPM as a program of record to solicit industry for a block buy of multiple units based upon the prototype design.

**E. Performance Metrics**

Completion of the Prototype Final Design Review (FDR)
Purchase/receipt of material

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |

Start prototype fabrication and assembly

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| 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 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Product Development | WR | NUWC NPT : Newport, RI | 0.199 | 0.606 | Oct 2017 | 1.166 | Oct 2018 | 1.265 | Oct 2019 | - | | 1.265 | Continuing | Continuing | Continuing |
| Product Development | WR | NSWC PD : Philadelphia, PA | 0.904 | 1.636 | Oct 2017 | 4.625 | Oct 2018 | 7.440 | Oct 2019 | - | | 7.440 | Continuing | Continuing | Continuing |
| Product Development | WR | NUWC KPT : Keyport, WA | 1.110 | 0.955 | Oct 2017 | 2.742 | Oct 2018 | 3.231 | Oct 2019 | - | | 3.231 | Continuing | Continuing | Continuing |
| Product Development | WR | PSNS : Bremerton, WA | 0.271 | 0.395 | Oct 2017 | 1.144 | Oct 2018 | 1.276 | Oct 2019 | - | | 1.276 | Continuing | Continuing | Continuing |
| Product Development | WR | NSWC CD : West Bethesda, MD | 0.300 | 0.139 | Oct 2017 | 0.875 | Oct 2018 | 0.449 | Oct 2019 | - | | 0.449 | Continuing | Continuing | Continuing |
| Product Development | WR | NRL : Washington, DC | 0.100 | 0.155 | Oct 2017 | 0.000 | Oct 2018 | 0.000 | Oct 2019 | - | | 0.000 | Continuing | Continuing | Continuing |
| Product Development | FFRDC | ARL/PSU : Arlington, VA | 0.075 | 0.210 | Oct 2017 | 0.000 | Oct 2018 | 0.000 | Oct 2019 | - | | 0.000 | Continuing | Continuing | Continuing |
| Product Development | WR | NSWC DD : Dahlgren, VA | 0.005 | 0.021 | Oct 2017 | 0.000 | Oct 2018 | 0.000 | Oct 2019 | - | | 0.000 | Continuing | Continuing | Continuing |
| Product Development | C/CPFF | DIUx : Mountain View, CA | 0.000 | 0.050 | Nov 2017 | 0.000 | Nov 2018 | 0.000 | Oct 2019 | - | | 0.000 | Continuing | Continuing | Continuing |
| Product Development | WR | PNSY : Portsmouth, NH | 0.435 | 0.162 | Oct 2017 | 0.000 | Oct 2018 | 0.000 | Oct 2019 | - | | 0.000 | Continuing | Continuing | Continuing |
| | | **Subtotal** | 3.399 | 4.329 | | 10.552 | | 13.661 | | - | | 13.661 | Continuing | Continuing | N/A |

**Management Services ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Travel | Allot | NAVSEA HQ : Washington DC | 0.043 | 0.044 | Oct 2017 | 0.045 | Oct 2018 | 0.046 | Oct 2019 | - | | 0.046 | Continuing | Continuing | Continuing |
| Contractor Management Services | C/CPAF | NTT Data : McLean, VA | 0.358 | 0.365 | Dec 2017 | 0.372 | Dec 2018 | 0.229 | Dec 2019 | - | | 0.229 | Continuing | Continuing | Continuing |
| | | **Subtotal** | 0.401 | 0.409 | | 0.417 | | 0.275 | | - | | 0.275 | Continuing | Continuing | N/A |

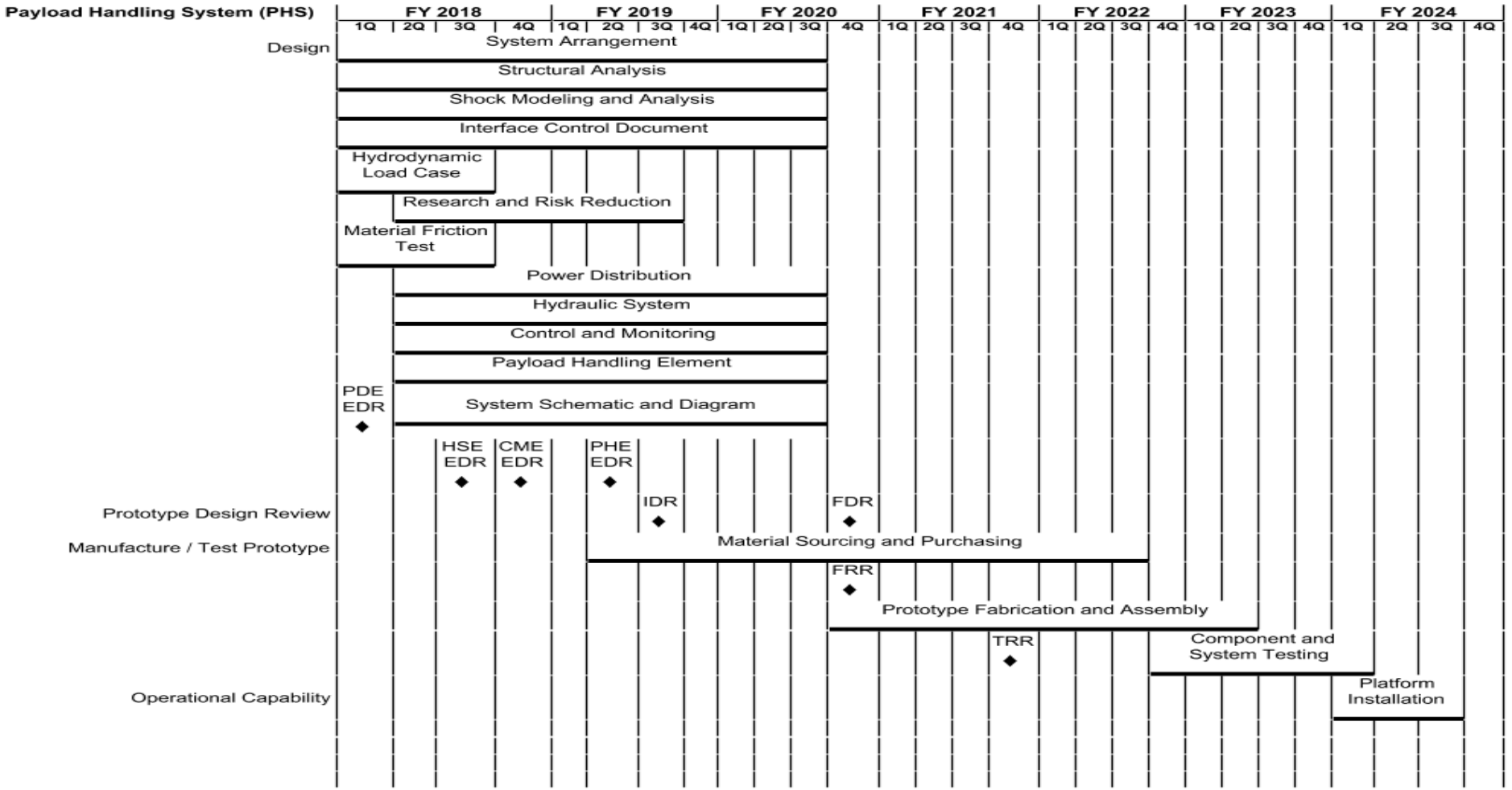
| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 4 | R-1 Program Element (Number/Name)<br>PE 0603561N / *Advanced Submarine System Development* | Project (Number/Name)<br>2096 / *Payload Delivery Development* | |

| | Prior Years | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Project Cost Totals** | 3.800 | 4.738 | | 10.969 | | 13.936 | | - | | 13.936 | Continuing | Continuing | N/A |

**Remarks**

The Navy terminated the SL-UKAS program in FY 20. This reduction is reflected in the current controls.

| Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |



| Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |

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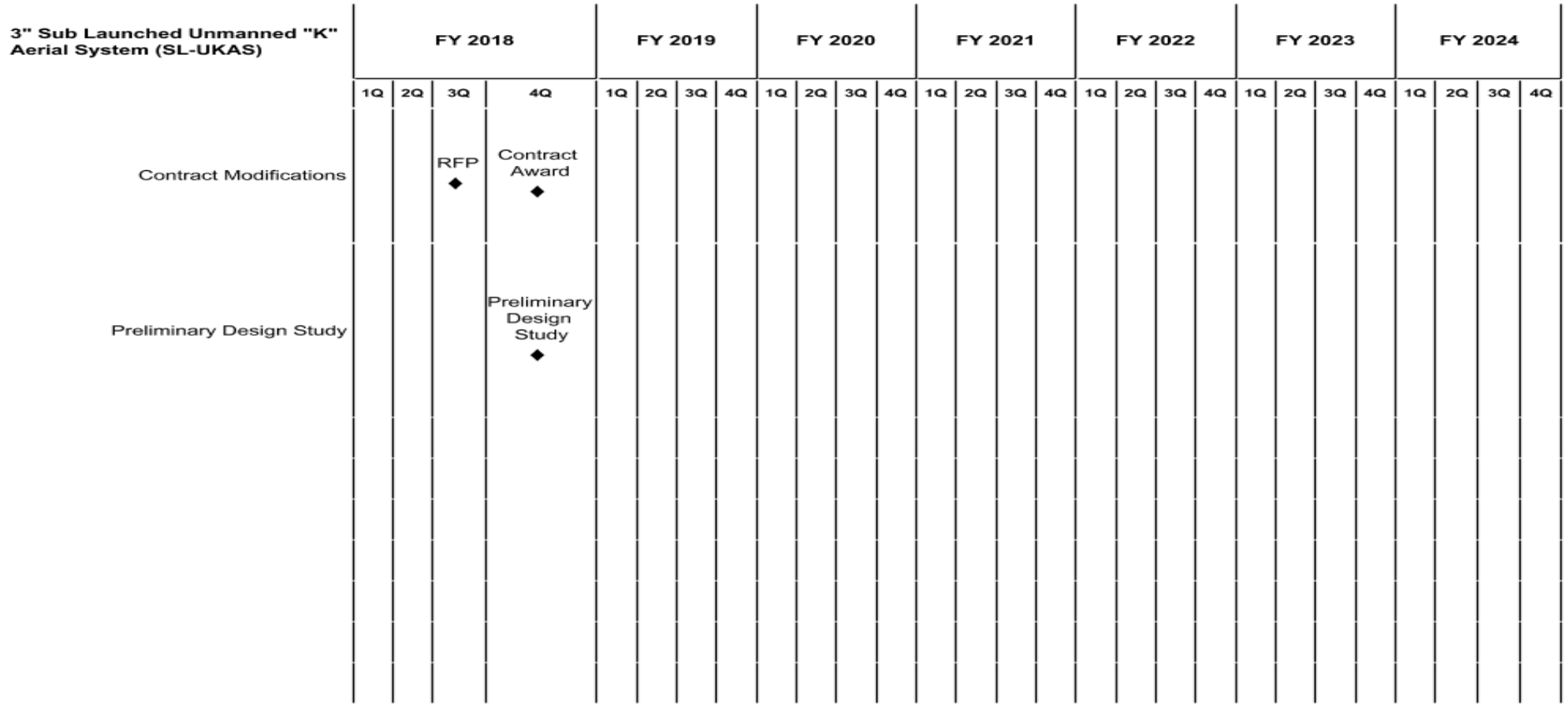
| Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / *Advanced Submarine System Development* | **Project (Number/Name)**<br>2096 / *Payload Delivery Development* |

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| Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |

## Schedule Details

| | Start | | End | |
|---|---|---|---|---|
| **Events by Sub Project** | **Quarter** | **Year** | **Quarter** | **Year** |
| ***Payload Handling System (PHS)*** | | | | |
| Design: System Arrangement Development | 1 | 2018 | 3 | 2020 |
| Design: Structural Analysis | 1 | 2018 | 3 | 2020 |
| Design: Shock Modeling and Analysis | 1 | 2018 | 3 | 2020 |
| Design: Interface Control Document | 1 | 2018 | 3 | 2020 |
| Design: Hydrodynamic Load Case Modeling and Analysis | 1 | 2018 | 3 | 2018 |
| Design: Material Research and Risk Reduction Fabrication | 2 | 2018 | 3 | 2019 |
| Design: Payload Handling Element Material Friction Test | 1 | 2018 | 3 | 2018 |
| Design: Power Distribution Element Design Development | 2 | 2018 | 3 | 2020 |
| Design: Hydraulic System Element Design Development | 2 | 2018 | 3 | 2020 |
| Design: Control and Monitoring Element Design Development | 2 | 2018 | 3 | 2020 |
| Design: Payload Handling Element Design Development | 2 | 2018 | 3 | 2020 |
| Design: System Schematic and Diagram Development | 2 | 2018 | 3 | 2020 |
| Design: Power Distribution Element Element Design Review (EDR) | 1 | 2018 | 1 | 2018 |
| Design: Hydraulic System Element EDR | 3 | 2018 | 3 | 2018 |
| Design: Control and Monitoring Element EDR | 4 | 2018 | 4 | 2018 |
| Design: Payload Handling Element EDR | 2 | 2019 | 2 | 2019 |
| Prototype Design Review: Initial Design Review (IDR) | 3 | 2019 | 3 | 2019 |
| Prototype Design Review: Final Design Review (FDR) | 4 | 2020 | 4 | 2020 |
| Manufacture / Test Prototype: Long Lead Time and Other Material Sourcing and Purchasing | 2 | 2019 | 3 | 2022 |
| Manufacture / Test Prototype: Fabrication Readiness Review (FRR) | 4 | 2020 | 4 | 2020 |

| Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |

| | Start | | End | |
|---|---|---|---|---|
| **Events by Sub Project** | **Quarter** | **Year** | **Quarter** | **Year** |
| Manufacture / Test Prototype: Prototype Fabrication and Assembly | 4 | 2020 | 2 | 2023 |
| Manufacture / Test Prototype: Test Readiness Review (TRR) | 4 | 2021 | 4 | 2021 |
| Manufacture / Test Prototype: Component and System Testing | 4 | 2022 | 1 | 2024 |
| Operational Capability: Platform Installation | 1 | 2024 | 3 | 2024 |
| ***3" Sub Launched Unmanned "K" Aerial System (SL-UKAS)*** | | | | |
| Contract Modifications: Request for Proposal (RFP) | 3 | 2018 | 3 | 2018 |
| Contract Modifications: Contract Award - Feasibilty Study | 4 | 2018 | 4 | 2018 |
| Preliminary Design Study: Preliminary Design Study: Payload Integration Feasibility Study | 4 | 2018 | 4 | 2018 |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| 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* | |

| COST ($ in Millions) | Prior Years | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total | FY 2021 | FY 2022 | FY 2023 | FY 2024 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3391: *SSN/SSGN Survivability Program* | 0.000 | 8.203 | 8.327 | 10.123 | - | 10.123 | 11.522 | 12.027 | 11.573 | 12.825 | Continuing | Continuing |
| Quantity of RDT&E Articles | | - | - | - | - | - | - | - | - | - | | |

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

In 2013, OPNAV N97 established SSN/SSGN Survivability Program (S3P) as a separate project area within ASSD to assure SSN/SSGN survivability and the ability of submarines to complete their joint warfighting missions even if covert mobility is compromised. The $1.8M budget increase in FY20 will allow S3P to develop specific countermeasure concept systems to address documented gaps in survivability on current submarines.

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| ***Title:*** SSN/SSGN Survivability Program | 8.203 | 8.327 | 10.123 | 0.000 | 10.123 |
| ***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 survivability and 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 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 operating in contested waters and the littorals. S3P supports fleet development of Tactics, Techniques, and Procedures (TTPs) that facilitate new or enhance existing warfighting concepts. | | | | | |
| ***FY 2019 Plans:***<br>S3P will continue to address gaps in stealth and survivability for the current and future SSN/SSGN force to include<br>responding to fleet questions on current tactical vulnerabilities and completion of an annual Operational Survivability | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| Assessment. S3P will conduct acoustic, non-acoustic, and non-traditional ASW vulnerability assessment projects, and will conduct sea tests in support of OPNAV N97 Acoustic Superiority. S3P will initiate a process to develop threat based assessments for a new attack submarine to address Tactical Submarine Evolution Plan (TSEP) requirements for the future. Details can be provided in a classified setting.<br>***FY 2020 Base Plans:***<br>S3P will continue to address gaps in stealth and survivability for the current SSN/SSGN force to include responding to fleet questions on current tactical vulnerabilities and completion of an annual Operational Survivability Assessment.<br>Continue analytical and technical work on TSEP and future SSN/SSGN survivability design basis.<br>S3P will conduct acoustic, non-acoustic, and non-traditional ASW vulnerability assessment projects, and will conduct sea tests in stealth requirements and countermeasure concepts. Complete two tactical decision concept projects for current fleet operations. Details can be provided in a classified setting. S3P will conduct sea tests with international partners for Advanced Signature Management/Countermeasures development.<br>***FY 2020 OCO Plans:***<br>N/A<br>***FY 2019 to FY 2020 Increase/Decrease Statement:***<br>Increase between FY19 and FY20 reflects transition of Advanced Signature Management project from PE 0603561N / 2033 Advanced Submarine System Development. S3P will conduct at-sea test projects to demonstrate countermeasure concepts for known vulnerabilities. | | | | | |
| **Accomplishments/Planned Programs Subtotals** | 8.203 | 8.327 | 10.123 | 0.000 | 10.123 |

**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

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |

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**

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 survivability and stealth requirements to OPNAV N97 and provide technical basis for Tactics, Techniques, and Procedures (TTP) developed by the Undersea Warfighting Development.

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |

**Product Development ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Product Development | MIPR | CNA: : Alex, VA | 0.000 | 0.562 | Jan 2018 | 0.448 | Jan 2019 | 0.500 | Jan 2020 | - | | 0.500 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | MIT-LL : Cambridge, MA | 0.000 | 0.200 | Oct 2017 | 0.627 | Oct 2018 | 0.600 | Oct 2019 | - | | 0.600 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | Raytheon : Portmouth, RI | 0.000 | 0.429 | Dec 2018 | 0.440 | Dec 2019 | 0.450 | Sep 2020 | - | | 0.450 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | JHU/APL : Laurel, MD | 0.000 | 2.042 | Jul 2018 | 1.737 | Jul 2019 | 1.000 | Jul 2020 | - | | 1.000 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | UT/ARL : Austin, TX | 0.000 | 0.367 | Aug 2018 | 0.700 | Aug 2019 | 0.800 | Aug 2020 | - | | 0.800 | Continuing | Continuing | Continuing |
| Product Development | WR | NUWC : Newport, RI | 0.000 | 0.900 | Apr 2018 | 1.000 | Apr 2019 | 1.000 | Apr 2020 | - | | 1.000 | Continuing | Continuing | Continuing |
| Product Development | MIPR | NRL : Washington, DC | 0.000 | 0.090 | Dec 2017 | 0.300 | Dec 2018 | 0.400 | Dec 2019 | - | | 0.400 | Continuing | Continuing | Continuing |
| Product Development | C/BA | NSMA : Not Specified | 0.000 | 0.782 | Dec 2017 | 0.900 | Dec 2018 | 0.920 | Dec 2019 | - | | 0.920 | Continuing | Continuing | Continuing |
| Product Development | SS/CPFF | Sonalysts : Groton, CT | 0.000 | 0.050 | Dec 2018 | 0.200 | Dec 2019 | 0.350 | Sep 2020 | - | | 0.350 | Continuing | Continuing | Continuing |
| Product Development | WR | SPAWAR : Charleston, SC | 0.000 | 0.050 | Aug 2018 | 0.100 | Aug 2019 | 0.050 | Aug 2020 | - | | 0.050 | Continuing | Continuing | Continuing |
| | | **Subtotal** | 0.000 | 5.472 | | 6.452 | | 6.070 | | - | | 6.070 | Continuing | Continuing | N/A |

**Support ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Travel and Corporate | WR | NAVSEA HQ : Not Specified | 0.000 | 0.040 | Oct 2017 | 0.340 | Oct 2018 | 0.360 | Oct 2019 | - | | 0.360 | Continuing | Continuing | Continuing |
| | | **Subtotal** | 0.000 | 0.040 | | 0.340 | | 0.360 | | - | | 0.360 | Continuing | Continuing | N/A |

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| 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 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Developmental Test & Evaluation | WR | NSWC : Carderock, MD | 0.000 | 2.371 | Apr 2018 | 1.205 | Apr 2019 | 3.353 | Apr 2020 | - | | 3.353 | Continuing | Continuing | Continuing |
| | | **Subtotal** | 0.000 | 2.371 | | 1.205 | | 3.353 | | - | | 3.353 | Continuing | Continuing | N/A |

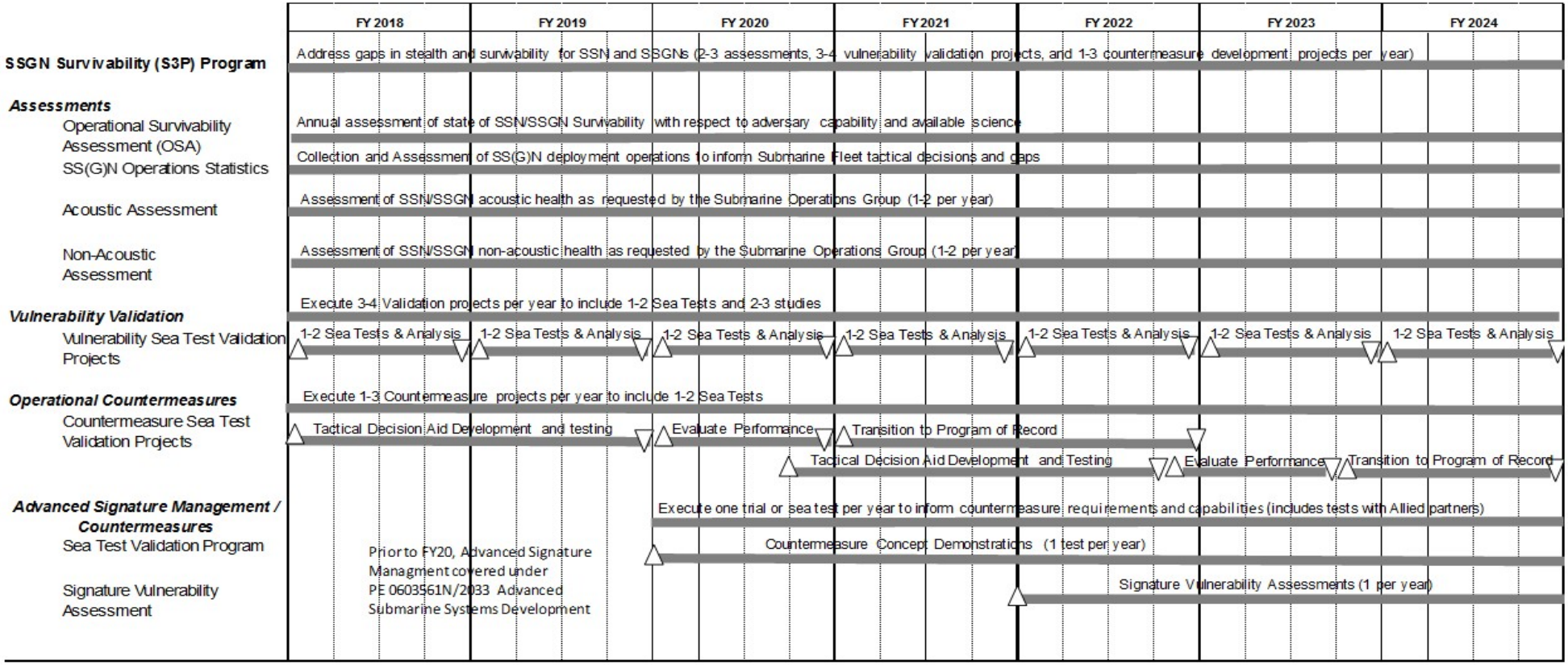
**Management Services ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Management Services | SS/CPFF | NSMA : Not Specified | 0.000 | 0.320 | Dec 2017 | 0.330 | Dec 2018 | 0.340 | Dec 2019 | - | | 0.340 | Continuing | Continuing | Continuing |
| | | **Subtotal** | 0.000 | 0.320 | | 0.330 | | 0.340 | | - | | 0.340 | Continuing | Continuing | N/A |

| | Prior Years | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Project Cost Totals** | 0.000 | 8.203 | | 8.327 | | 10.123 | | - | | 10.123 | Continuing | Continuing | N/A |

**Remarks**

| Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |

## Schedule Details

| | Start | | End | |
|---|---|---|---|---|
| **Events by Sub Project** | **Quarter** | **Year** | **Quarter** | **Year** |
| ***Assessments*** | | | | |
| Operational Survivability Assessment | 1 | 2018 | 4 | 2024 |
| Acoustic Assessment | 1 | 2018 | 4 | 2024 |
| Non-Acoustic Assessment | 1 | 2018 | 4 | 2024 |
| ***Vulnerability Validation*** | | | | |
| Vulnerability SEA Test Validation Program (1-2 per year) | 1 | 2018 | 4 | 2024 |
| ***Countermeasures*** | | | | |
| Countermeasure Validation (2-3 per year) | 1 | 2018 | 4 | 2024 |
| ***Advanced Submarine Signature Management/Countermeasures*** | | | | |
| Sea Test Validation Program (1 per year) | 1 | 2020 | 4 | 2024 |
| Signature Vulnerability Assessment (1 per year) | 1 | 2022 | 4 | 2024 |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| Appropriation/Budget Activity<br>1319 / 4 | R-1 Program Element (Number/Name)<br>PE 0603561N / *Advanced Submarine System Development* | Project (Number/Name)<br>9710 / *Advanced Submarine Technology Development* | |

| COST ($ in Millions) | Prior Years | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total | FY 2021 | FY 2022 | FY 2023 | FY 2024 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9710: *Advanced Submarine Technology Development* | 0.000 | 0.000 | 0.000 | 38.689 | - | 38.689 | 60.476 | 45.705 | 63.665 | 75.464 | Continuing | Continuing |
| Quantity of RDT&E Articles | | - | - | - | - | - | - | - | - | - | | |

**Note**

This program was previously funded in FY 2019 under Program Element 0604250D8Z (Advanced Innovative Technologies) Project 250 (Advanced Innovative Technologies). This is a Navy new start.

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

The Advanced Submarine Technology Development effort is responsible for evaluating and transitioning new payload capabilities into the fleet. The integration effort will transition the results of the Office of the Secretary of Defense (OSD) Strategic Capabilities Office (SCO) demonstration program to rapidly integrate a more permanent capability onto additional undersea platforms. Developmental engineering, additional design work, award of the development contract, and conduct of the PDR will take place in FY2020. Currently, there are two major efforts funded for required transition: (1) integration of Project 1 payload and (2) development of a new Payload Launch Device (PLD) to support future submarine launched payloads. Further details can be provided at a higher classification.

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| ***Title:*** New Payload Launcher Device (PLD) | 0.000 | 0.000 | 9.790 | 0.000 | 9.790 |
| ***Articles:*** | - | - | - | - | - |
| ***Description:*** In FY2020 a New Payload Launcher Device (PLD) will be developed to eject payloads out of current submarine ejection systems. The current device lacks the energetic capacity to support the weight and scope of desired larger payloads (Project 1 and others). Rapid development of the new device allows for early integration and testing support for these future payloads, avoiding later costs and redesign of the payload systems. FY2020 efforts include development through preliminary design review (PDR) and critical design review (CDR), and future analysis of other payloads. Further details of this project can be provided at a higher classification. | | | | | |
| ***FY 2019 Plans:***<br>N/A | | | | | |
| ***FY 2020 Base Plans:***<br>- Design and tradeoff analysis<br>- Develop new design and Technical Data Package (TDP) | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / *Advanced Submarine System Development* | **Project (Number/Name)**<br>9710 / *Advanced Submarine Technology Development* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| - Award New PLD Development Contract<br>- Conduct PDR<br>***FY 2020 OCO Plans:***<br>N/A<br>***FY 2019 to FY 2020 Increase/Decrease Statement:***<br>- FY20 addition begins initial development effort for New Payload Launcher Device (PLD) based on safety interactions from advanced demonstration program. | | | | | |
| ***Title:*** Project 1 | 0.000 | 0.000 | 28.899 | 0.000 | 28.899 |
| ***Articles:*** | - | - | - | - | - |
| ***Description:*** Project 1 leverages a separately funded advanced demonstration initiative that launches an existing payload (Payload 1) from U.S. Submarine classes. The payload and ship system integration are managed by separate programs, with further details classified. The integration effort will transition the results of the Office of the Secretary of Defense (OSD) Strategic Capabilities Office (SCO) demonstration program to rapidly integrate a more permanent capability onto additional undersea platforms. Developmental engineering, additional design work, award of the development contract, and conduct of the PDR will take place in FY2020.<br>***FY 2019 Plans:***<br>N/A<br>***FY 2020 Base Plans:***<br>- Support advanced demonstration of capability within the fleet<br>- Begin development of Project 1 unique support equipment and design for ship integration and robustness<br>- Initial developmental engineering efforts and reviews<br>- Begin system engineering and design of components<br>- Award Project 1 Development Contract<br>- Conduct PDR<br>***FY 2020 OCO Plans:***<br>N/A<br>***FY 2019 to FY 2020 Increase/Decrease Statement:*** | | | | | |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / *Advanced Submarine System Development* | **Project (Number/Name)**<br>9710 / *Advanced Submarine Technology Development* |

| B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each) | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total |
|---|---|---|---|---|---|
| - FY20 addition begins transition of the program from OSD SCO Program Element 0604250D8Z (Advanced Innovative Technologies) Project 250 (Advanced Innovative Technologies). | | | | | |
| **Accomplishments/Planned Programs Subtotals** | 0.000 | 0.000 | 38.689 | 0.000 | 38.689 |

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

| Line Item | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total | FY 2021 | FY 2022 | FY 2023 | FY 2024 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| • OMN/1D4D: *Weapons Maintenance* | 1,229.077 | 1,310.348 | 924.069 | 486.188 | 1,410.257 | 990.572 | 1,227.069 | 1,257.463 | 1,281.739 | 0.000 | 8,706.525 |

**Remarks**

**D. Acquisition Strategy**

Project 1 systems engineering will build from the demonstration program, allowing for design and testing work to be executed rapidly. The first phase of Project 1 leverages the existing demonstration design for large interface hardware and an already written Shock Qualification Plan to complete a spiral design upgrade of the interface hardware. This hardware is large, manufacturing intensive, and already known to be on the critical path. The demonstration program has proven that contracting for the material and manufacturing of these components all at once saves money and reduces risk. The large metal components can be quickly designed, manufactured, and turned over to begin the process of shock analysis and testing. Systems engineering and design of other components can be executed in parallel and will also begin in FY2020. Contract Award, design work to include PDR will occur in FY2020 and CDR and EDM item procurement are to happen in FY2021 for major components. The ejection system used for demonstration is inadequate for tactical use of this payload, requiring spiral design of several critical components. Contract award and design work through preliminary design review will happen in FY 2020 for these subsystems.

The New Payload Launcher Device (PLD) will develop an ejection system that is safety compliant and that has adequate energy to launch future payloads. An Other Transactional Authority (OTA) contract managed by NUWC Newport will be used to rapidly award the design, build and test the system. Initial design and development, to include preliminary design and critical design reviews, will occur by end of FY2020. Manufacturing of engineering development models and test of these units will occur in FY2021 to support test and final certification. The EDM units will be completed in FY2022 with necessary testing to achieve certification for system safety and operational use by end of FY2022. This timeline supports providing these ejection devices to the development efforts of other payloads for early integration, avoiding redesign and rework costs. Future systems will either be built by Government agencies or contracted through payload manufacturer contracts.

**E. Performance Metrics**

Progress Reviews
Execution Reporting and Reviews
Milestone Reviews

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / *Advanced Submarine System Development* | **Project (Number/Name)**<br>9710 / *Advanced Submarine Technology Development* | |

**Product Development ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| New Payload Launcher Device - Development | TBD | TBD : TBD | 0.000 | 0.000 | | 0.000 | | 7.527 | Feb 2020 | - | | 7.527 | Continuing | Continuing | Continuing |
| New Payload Launcher Device - System Engineering | WR | NUWC : Newport, RI | 0.000 | 0.000 | | 0.000 | | 1.882 | Dec 2019 | - | | 1.882 | Continuing | Continuing | Continuing |
| Project 1 - Development | TBD | TBD : TBD | 0.000 | 0.000 | | 0.000 | | 21.895 | Feb 2020 | - | | 21.895 | Continuing | Continuing | Continuing |
| Project 1 - System Engineering | WR | NUWC : Newport, RI | 0.000 | 0.000 | | 0.000 | | 5.485 | Dec 2019 | - | | 5.485 | Continuing | Continuing | Continuing |
| | | **Subtotal** | 0.000 | 0.000 | | 0.000 | | 36.789 | | - | | 36.789 | Continuing | Continuing | N/A |

**Remarks**

In FY2020 New Payload Launcher Device (PLD) Program begins redesign development effort for new payload launch device based on safety interactions from advanced demonstration program and will develop new design and TDP, award the new PLD development contract and conduct PDR and CDR.
In FY2020 Project 1 begins transition program from separately funded demonstration program and will begin development of unique support equipment and design for ship integration and robustness; award Project 1 Development Contract; begin system engineering and design of components and conduct PDR.

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

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| New Payload Launcher Device | WR | NUWC : Newport, RI | 0.000 | 0.000 | | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 0.000 | - |
| Project 1 | WR | NUWC : Newport, RI | 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 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| New Payload Launcher Device - Program Management Support | C/CPAF | BOOZ ALLEN : Washington, D.C. | 0.000 | 0.000 | | 0.000 | | 0.300 | Dec 2019 | - | | 0.300 | Continuing | Continuing | Continuing |

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / *Advanced Submarine System Development* | **Project (Number/Name)**<br>9710 / *Advanced Submarine Technology Development* |

**Management Services ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project 1- Program Management Support | C/CPAF | BOOZ ALLEN : Washington, D.C | 0.000 | 0.000 | | 0.000 | | 1.500 | Dec 2019 | - | | 1.500 | Continuing | Continuing | Continuing |
| Travel | WR | NAVSEA : Washington, D.C | 0.000 | 0.000 | | 0.000 | | 0.100 | Sep 2020 | - | | 0.100 | 0.000 | 0.100 | - |
| | | **Subtotal** | 0.000 | 0.000 | | 0.000 | | 1.900 | | - | | 1.900 | Continuing | Continuing | N/A |

**Remarks**

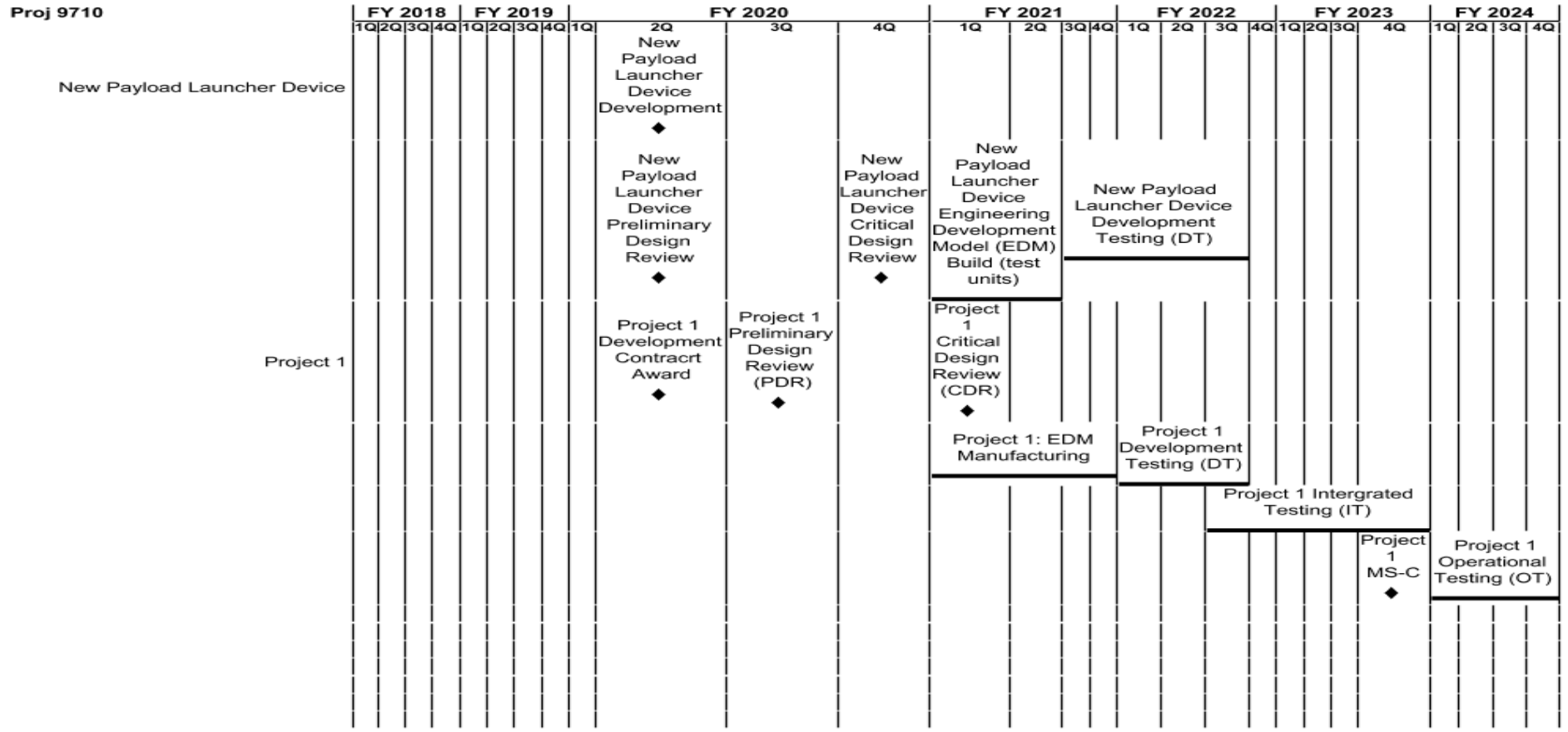
Travel increase from FY2019 to FY2020 covers the travel for the two new development programs beginning in FY2020, New Payload Launcher Device and Project 1.

| | Prior Years | FY 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Project Cost Totals** | 0.000 | 0.000 | | 0.000 | | 38.689 | | - | | 38.689 | Continuing | Continuing | N/A |

**Remarks**

In FY2020, Project 9710, Project 1 and New Payload Launcher Device (PLD) Program transitions Project 1 from a separately funded demonstration program and begins the redesign of the MK75 Gas Generator (New PLD). Both programs will award development contracts in FY2020.

| Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / *Advanced Submarine System Development* | **Project (Number/Name)**<br>9710 / *Advanced Submarine Technology Development* |




2020PB - 0603561N - 9710

| Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **Appropriation/Budget Activity**<br>1319 / 4 | **R-1 Program Element (Number/Name)**<br>PE 0603561N / *Advanced Submarine System Development* | **Project (Number/Name)**<br>9710 / *Advanced Submarine Technology Development* |

## Schedule Details

| | Start | | End | |
|---|---|---|---|---|
| **Events by Sub Project** | **Quarter** | **Year** | **Quarter** | **Year** |
| ***Proj 9710*** | | | | |
| New Payload Launcher Device: Development Contracrt Award | 2 | 2020 | 2 | 2020 |
| New Payload Launcher Device: Preliminary Design Review (PDR) | 2 | 2020 | 2 | 2020 |
| New Payload Launcher Device: Critical Design Review (CDR) | 4 | 2020 | 4 | 2020 |
| New Payload Launcher Device: Engineering Development Model (EDM) Build (test units) | 1 | 2021 | 2 | 2021 |
| New Payload Launcher Device: Development Testing (DT) | 3 | 2021 | 3 | 2022 |
| Project 1: Development Contracrt Award | 2 | 2020 | 2 | 2020 |
| Project 1: Preliminary Design Review (PDR) | 3 | 2020 | 3 | 2020 |
| Project 1: Critical Design Review (CDR) | 1 | 2021 | 1 | 2021 |
| Project 1: Project 1: EDM Manufacturing | 1 | 2021 | 4 | 2021 |
| Project 1: Development Testing (DT) | 1 | 2022 | 3 | 2022 |
| Project 1: Intergrated Testing (IT) | 3 | 2022 | 4 | 2023 |
| Project 1: MS-C | 4 | 2023 | 4 | 2023 |
| Project 1: Operational Testing (OT) | 1 | 2024 | 4 | 2024 |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| 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* | |

| COST ($ in Millions) | Prior Years | FY 2018 | FY 2019 | FY 2020 Base | FY 2020 OCO | FY 2020 Total | FY 2021 | FY 2022 | FY 2023 | FY 2024 | Cost To Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9999: *Congressional Adds* | 0.000 | 4.825 | 10.000 | 0.000 | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 14.825 |
| Quantity of RDT&E Articles | | - | - | - | - | - | - | - | - | - | | |

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

LITTORAL WATER THREATS. Environmentally characterize the South Florida Ocean Measurement Facility (SFOMF) underwater test range battlespace, upgrade the sensors and infrastructure, and conduct at least two characterization tests of a Virginia Class Submarine to validate model data.

LIGHTWEIGHT COMPOSITE RESEARCH. Continue to develop and demonstrate composite material technologies for future submarines in areas of non-traditional/ advanced materials for hull and platform technologies, propulsors, propellers, and other systems which increase near-term capability and provide cost reduction for in-service and future submarine classes.

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2018 | FY 2019 |
|---|---|---|
| ***Congressional Add:*** Littoral Water Threats<br>***FY 2018 Accomplishments:*** Initiated planning for SFOMF 3-D environmental characterization and range infrastructure upgrade. Developed Underwater Electro-Magnetics (UEM) Strategic Plan and established initial "Need Lines" for future technical development. Replaced SFOMF range magnetometers.<br>***FY 2019 Plans:*** Complete 3-D environmental characteristics of the water space and validate models of the operating area. Upgrade SFOMF range infrastructure, including environmental hardware, sensors, data and power cables, and supporting detection/processing algorithms and associated hardware. Update UEM models and develop environmental threat conditions for future submarine designs. Complete analysis of FY18 prototype trial. Perform SFOMF detection array upgrade. Conduct modeling and planning for sea trials on two Virginia Class Submarines. | 4.825 | 5.000 |
| ***Congressional Add:*** Lightweight Composite Research<br>***FY 2018 Accomplishments:*** N/A<br>***FY 2019 Plans:*** AMP. Finalize structural acceptance process for the Advanced Material Propeller (AMP), including fatigue testing of Generation 2 composite blades in partner country, data analysis, and finite element analysis. Complete the structural certification and planning for AMP sea trials, obtain approval from cognizant technical authorities that AMP is acceptable for trial, and provide partner country with supporting documentation package. | 0.000 | 5.000 |

| Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |

| B. Accomplishments/Planned Programs ($ in Millions) | FY 2018 | FY 2019 |
|---|---|---|
| NEXT GEN THRUST. Continue design studies and plan small and/or large scale testing of innovative, advanced material propulsor and shafting technologies. Complete detailed design of a composite shaft. Begin test article fabrication, testing, and composite shaft manufacture. Continue evaluation and design of a next generation propulsor concept utilizing new/non-traditional materials.<br><br>NEW COMPOSITE APPLICATIONS. Conduct composite material design and demonstration feasibility studies to explore and validate new applications of composite materials on submarines. | | |
| **Congressional Adds Subtotals** | 4.825 | 10.000 |

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

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**E. Performance Metrics**

LITTORAL WATER THREATS. Complete SFOMF environmental analysis, complete range upgrades, update models and complete one Virginia Class Submarine characterization test at SFOMF to validate modeling data.

LIGHTWEIGHT COMPOSITE RESEARCH. AMP. Complete structural Objective Quality Evidence package and structural certification of prototype Advanced Material Propeller (AMP) for at-sea testing and deliver full-scale AMP for at-sea testing, with supporting documentation.

NEXT GEN THRUST. Produce documentation of composite shaft design, material test results, analysis results, and independent assessments. Produce documentation of next generation SSN propulsor concept design, to include performance predictions.

NEW COMPOSITE APPLICATIONS: Identify new/alternate applications for composite technology.

| Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| 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 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Product Development | Various | NSWC/CD : Bethesda, MD | 0.000 | 2.375 | Dec 2018 | 8.618 | Dec 2019 | 0.000 | | - | | 0.000 | 0.000 | 10.993 | - |
| Product Development | Various | NOVA Southeastern University : Ft. Lauderdale, FL | 0.000 | 2.350 | Dec 2018 | 0.000 | | 0.000 | | - | | 0.000 | 0.000 | 2.350 | - |
| Product Development | Various | SPA : Washington, DC | 0.000 | 0.000 | | 0.294 | Dec 2019 | 0.000 | | - | | 0.000 | 0.000 | 0.294 | - |
| Product Development | Various | ARL/PSU: : State College, PA | 0.000 | 0.000 | | 0.746 | Dec 2019 | 0.000 | | - | | 0.000 | 0.000 | 0.746 | - |
| | | **Subtotal** | 0.000 | 4.725 | | 9.658 | | 0.000 | | - | | 0.000 | 0.000 | 14.383 | N/A |

**Support ($ in Millions)**

| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Product Development | Various | NTT : Washington, DC | 0.000 | 0.100 | Dec 2018 | 0.100 | Dec 2019 | 0.000 | | - | | 0.000 | 0.000 | 0.200 | - |
| Product Development | Various | Contractor Support : Various | 0.000 | 0.000 | | 0.192 | Jan 2019 | 0.000 | | - | | 0.000 | 0.000 | 0.192 | - |
| Product Development | Various | Gov Engineering : Various | 0.000 | 0.000 | | 0.050 | Jan 2019 | 0.000 | | - | | 0.000 | 0.000 | 0.050 | - |
| | | **Subtotal** | 0.000 | 0.100 | | 0.342 | | 0.000 | | - | | 0.000 | 0.000 | 0.442 | N/A |

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

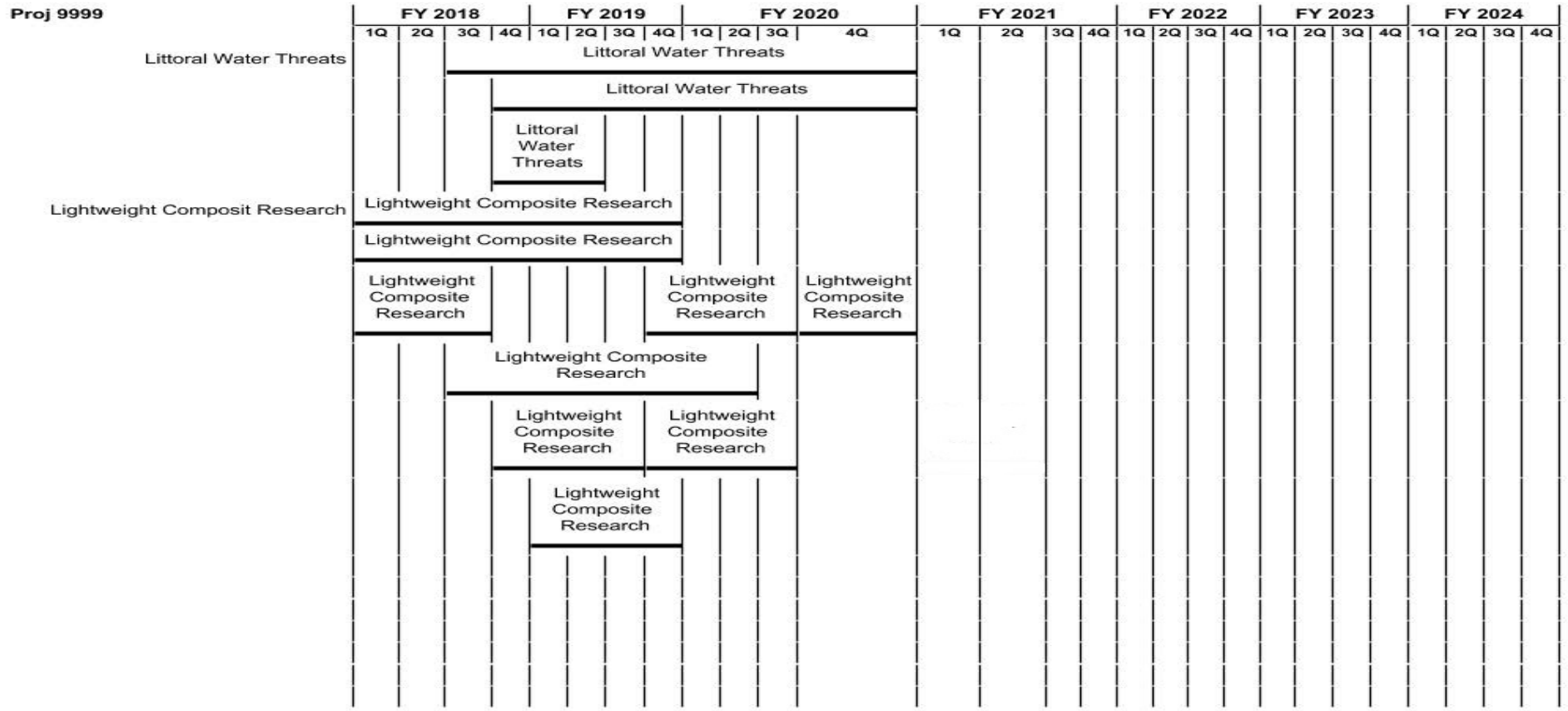
| Cost Category Item | Contract Method & Type | Performing Activity & Location | Prior Years | FY 2018 Cost | FY 2018 Award Date | FY 2019 Cost | FY 2019 Award Date | FY 2020 Base Cost | FY 2020 Base Award Date | FY 2020 OCO Cost | FY 2020 OCO Award Date | FY 2020 Total Cost | Cost To Complete | Total 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 2020 Navy | | | Date: March 2019 |
|---|---|---|---|
| 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 2018 | | FY 2019 | | FY 2020 Base | | FY 2020 OCO | | FY 2020 Total | Cost To Complete | Total Cost | Target Value of Contract |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Project Cost Totals** | 0.000 | 4.825 | | 10.000 | | 0.000 | | - | | 0.000 | 0.000 | 14.825 | N/A |

**Remarks**

| Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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* |




*2020PB - 0603561N - 9999*

| Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy | | Date: March 2019 |
|---|---|---|
| **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*** | | | | |
| Littoral Water Threats: Test RangeSensor and Infrastructure upgrades | 3 | 2018 | 4 | 2020 |
| Littoral Water Threats: Test Planning, Execution and Analysis | 4 | 2018 | 4 | 2020 |
| Littoral Water Threats: Environmental/UEM Modeling and Characterization | 4 | 2018 | 2 | 2019 |
| Lightweight Composite Research: AMP: Complete structural certification process, assemble and test AMP Gen 3 blades and hub | 1 | 2019 | 4 | 2019 |
| Lightweight Composite Research: AMP: Deliver and install AMP propeller and supporting documentation to partner country | 4 | 2019 | 3 | 2020 |
| Lightweight Composite Research: AMP: At-sea test of AMP on partner submarine | 4 | 2020 | 4 | 2020 |
| Lightweight Composite Research: Next Gen Thrust: Complete Test Article design, fabrication and testing | 1 | 2019 | 3 | 2020 |
| Lightweight Composite Research: Next Gen Thrust: Complete design for Integrated Shaft and Propulsor | 1 | 2019 | 3 | 2019 |
| Lightweight Composite Research: Next Gen Thrust: Manufacture/assemble Integrated Shaft and Propulsor | 4 | 2019 | 3 | 2020 |
| Lightweight Composite Research: new Composite Applications: Conduct composite material design and demonstration feasibility studies | 1 | 2019 | 4 | 2019 |