Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Navy											Date: March 2019	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 4: *Advanced Component Development & Prototypes (ACD&P)*					R-1 Program Element (Number/Name) PE 0603595N *I (U)SSBN New Design*							
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	2,425.751	775.624	542.846	419.051	-	419.051	313.582	196.261	171.766	187.173	Continuing	Continuing
3220: *COLUMBIA Class Submarine Development*	2,425.751	751.497	514.846	419.051	-	419.051	313.582	196.261	171.766	187.173	Continuing	Continuing
9999: *Congressional Adds*	0.000	24.127	28.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	52.127
Program MDAP/MAIS Code: **Project MDAP/MAIS Code(s):** P444												

A. Mission Description and Budget Item Justification

The FY2020 funding request was reduced by $2.5M to account for the availability of prior year execution balances.

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

The funding applies to the design, systems engineering, prototyping, and vendor qualification activities needed to execute the schedule for Common Missile Compartment (CMC) design, whole ship design, and component technologies development for the next generation U.S. ballistic missile submarine (SSBN), the COLUMBIA Class.

Project Unit 3220:

The objective of the SSBN New Design project, the COLUMBIA Class is to design and prepare for construction of the replacement of the OHIO Class SSBN.

Project Unit 9999:

This Congressional Add project funds efforts for the Advanced Materials Propeller Program and Naval Propulsion Foundry Center Facility Power Upgrades.

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Navy	Date: March 2019
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 4: *Advanced Component Development & Prototypes (ACD&P)*	**R-1 Program Element (Number/Name)** PE 0603595N *I (U)SSBN New Design*

B. Program Change Summary ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	776.158	514.846	433.296	-	433.296
Current President's Budget	775.624	542.846	419.051	-	419.051
Total Adjustments	-0.534	28.000	-14.245	-	-14.245
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	28.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-25.538	0.000			
• Program Adjustments	0.000	0.000	-11.016	-	-11.016
• Rate/Misc Adjustments	0.004	0.000	-3.229	-	-3.229
• Congressional Add Adjustments	25.000	-	-	-	-

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2018	FY 2019
Project: 9999: *Congressional Adds*		
Congressional Add: *Advanced Materials Propeller Program*	24.127	15.000
Congressional Add: *Naval Propulsion Foundry Center Facility Power Upgrades*	0.000	13.000
Congressional Add Subtotals for Project: 9999	24.127	28.000
Congressional Add Totals for all Projects	24.127	28.000

Change Summary Explanation

The FY 2020 funding request was reduced by $14.245M due to the following program adjustments: -$5.950M to support COLUMBIA MILCON requirements; + $4.5M to support lead ship non-recurring engineering; -$2.5M to account for the availability of prior year execution balances; -$4.9M for classified issues; -$2.166 for Contract Services reform; and -$3.229M for rate/misc adjustments.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603595N / *(U)SSBN New Design*	Project (Number/Name) 3220 / *COLUMBIA Class Submarine 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
3220: *COLUMBIA Class Submarine Development*	2,425.751	751.497	514.846	419.051	-	419.051	313.582	196.261	171.766	187.173	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

Project MDAP/MAIS Code: P444

A. Mission Description and Budget Item Justification

The COLUMBIA Submarine Class Program (previously the OHIO Replacement Class) is developing the next generation sea-based strategic deterrent. The funding applies to the design, systems engineering, prototyping, and vendor qualification activities needed to execute the schedule for Common Missile Compartment (CMC) design, whole ship design, and component technologies development for the next generation U.S. ballistic missile submarine (SSBN). This RDT&E program supports cooperation with the United Kingdom (UK) to maintain strategic deterrence, based on a single effort to develop a CMC as agreed by the UK Secretary of State for Defense and the U.S. Secretary of Defense in 2009.
The COLUMBIA program strategy is to leverage the re-use of existing Submarine systems (as applicable), focus on lifecycle Total Ownership Cost (TOC) affordability, and meet the military requirements established for this SSBN to achieve mission success in a challenging environment. The requested funding levels provide for the Technology Development, Design, Engineering, and Integration efforts necessary to support the COLUMBIA Class SSBN lead ship construction start in FY 2021 along with continued development efforts for the class.

The following key activities support the COLUMBIA Class SSBN Program:
1. Design and development of a missile compartment, launch system, and Strategic Weapons Support Systems (SWSS) to meet U.S. strategic requirements while cooperating with the UK on modernizing its strategic deterrent in accordance with Presidential direction (December 2006).
2. Concept Definition, System Definition, and Detailed Design for remaining portions of the ship will be accomplished through a Design/Build/Sustain approach modeled after the approach used by the VIRGINIA Class program.
3. Engineering and integration of existing technologies and development of new technologies required to provide the capabilities necessary to ensure platform operational effectiveness and minimize life cycle cost.

COLUMBIA Class SSBN concept study, system definition prototyping, and technology development efforts support design, systems engineering, component development and vendor qualification activities needed to develop the CMC design and the COLUMBIA whole ship design. The COLUMBIA design timelines are based on a design approach proven on the VIRGINIA Class Program, adjusted for the additional complexity of a missile compartment and Strategic Weapons Systems (SWS). Planned technical studies and prototyping are necessary to reduce risks associated with updating SSBN system designs for current technical standards and demonstrating design feasibility of developmental technology to meet the ship design and construction schedule.

The Navy continues to invest in program funded affordability initiatives similar to those employed successfully for VIRGINIA Class, but tailored to the unique SSBN mission and operational tempo of COLUMBIA Class to drive down overall program costs. Efforts focus on reducing ship construction costs through implementing

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
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more effective design features and fabrication and assembly methods for a more affordable submarine. As part of this effort, alternative procurement and contracting strategies are also being examined to include Multi-Program Material Procurement (MPMP) and Economic Order Quantity (EOQ).

FY18 activities were executed for the first article quad pack (FAQP) prototype of the CMC to support the UK DREADNOUGHT Program and COLUMBIA Program, and to continue validation of the Integrated Tube and Hull (ITH) build strategy. These activities included the continuation of the construction of the FAQP, which began August 2016, with a planned completion in 2019. The CMC program will mature required technologies and re-host the TRIDENT II D5 SWS (Launcher, Fire Control and Navigation) while ensuring no degradation to D5 security, safety, and performance. In addition, whole ship design efforts are focused on technologies requiring significant engineering, integration, and development time as well as those technologies that are required to support ship design and construction schedules such as the propulsor and maneuvering/ship control. These technologies are critical for stealth capability for a ship class that will be in service until the 2080s. Ship detailed design efforts include important pre-construction activities such as finalizing ship arrangements, development of design disclosures to support build products, risk characterization, and mitigation, improvement and validation of performance prediction tools and improvement of design tools. Technology development will address engineering and integration of existing technologies as well as maturation of developmental technologies.
On 14 December 2016, the Secretary of the Navy announced the lead ship of the OHIO Replacement Program will be USS COLUMBIA (SSBN 826) which officially designates this program the COLUMBIA Class Submarine Program.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: Common Missile Compartment Design and Prototyping, and Whole Ship Design	274.315	165.730	155.121	0.000	155.121
Articles:	-	-	-	-	-
FY 2019 Plans: The combination of CMC Design and Prototyping and Ship Study and Design represents the required LDY Shipbuilder effort for the COLUMBIA Program. NOTE - The Design Completion percentage in the PB18 submission inadvertently reported the FY19 goal; it should have been what is reflected here. Design is on schedule. CMC Design and Prototyping: CMC Design and Prototyping: This funding applies to the design, systems engineering, prototyping, and vendor qualification activities needed to execute the schedule for CMC design and component / technology development for the COLUMBIA submarine. Included in this effort is continued development of CMC design products. Specific planned efforts in FY 2019 include: - The completion of approximately 20 percent of logistics technical documentation, and supportability assessments (360 CMC logistics technical documents) - 95 percent of CMC Design Disclosures (964 design disclosures) - Continued fabrication of MTs					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603595N / *(U)SSBN New Design*	**Project (Number/Name)** 3220 / *COLUMBIA Class Submarine Development*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
- Completion of manufacturing of the FAQP and continued manufacturing in support of the Missile Tube Module - Continued development and delivery of SWSS systems for the land based test facility Whole Ship Study and Design: This funding applies to the shipbuilder design, systems engineering, prototyping, and vendor qualification activities needed to execute the schedule for whole ship design and component / technology development for the COLUMBIA submarine. Specific efforts in FY 2019 include: - The completion of 97 percent of total Arrangements (approximately 4000 arrangement disclosures including CMC arrangement) -58 percent of total Design Disclosures (approximately 2698 design disclosures including CMC design disclosures) -Approximately 7 percent of logistics technical documentation, and supportability assessments (approximately 900 logistics technical documents including CMC technical documentation) - Efforts will also continue towards integration of all CMC interfaces with Rest of Ship and progressing ship integration of the Propulsor design Funding profile was adjusted from PB19 budget values in FY18 and FY19 to align with negotiated Integrated Product and Process Development (IPPD) requirements. ***FY 2020 Base Plans:*** The combination of CMC Design and Prototyping with Whole Ship Study and Design represents the required LDY Shipbuilder effort for the COLUMBIA Program. CMC Design and Prototyping: This funding applies to the design, systems engineering, prototyping, and vendor qualification activities needed to execute the schedule for CMC design and component / technology development for the COLUMBIA submarine. Included in this effort is continued development of CMC design products. Specific planned efforts in FY 2020 include: -30 percent of logistics technical documentation, and supportability assessments (approximately 550 CMC logistics technical documents) - The completion of all CMC Design Disclosures (approximately 1053 design disclosures) in support of the MTM build					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
- Formal start of Lead Ship Construction in October 2020 which includes continued fabrication of MTs, manufacture of the MTM and final delivery, and integration and test of SWSS systems for the land based test facility Whole Ship Study and Design: This funding applies to the shipbuilder design, systems engineering, prototyping, and vendor qualification activities needed to execute the schedule for whole ship design and component / technology development for the COLUMBIA submarine. Specific efforts in FY 2020 include: - The completion of all Arrangements (approximately 4100 arrangement disclosures including CMC arrangement) - 83 percent of total Design Disclosures (approximately 3861 design disclosures including CMC design disclosures) - Approximately 20 percent of logistics technical documentation, and supportability assessments (approximately 2050 logistics technical documents including CMC technical documentation) Lead Ship Construction efforts commence in October 2020. Efforts will also continue towards integration of all CMC interfaces with Rest of Ship and progressing ship integration of the Propulsor design. ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Overall efforts transitioning to Detailed Design and construction efforts.					
Title: NAVSEA R&D and Prototyping	241.029	171.940	153.667	0.000	153.667
Articles:	-	-	-	-	-
FY 2019 Plans: This funding applies to the Government combat systems, component and technology development for the COLUMBIA submarine essential to achieving required survivability, combat and communications capabilities. Efforts planned in FY 2019 include: Combat Systems: - Continue refinement and T1-20 updates to GFI to support detailed design, production, and manufacturing integration					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
- Continued assessment of AN/BRR-6 reliability based updates, including land based system development and test - Early environmental qualification testing of Government Furnished Equipment supporting Columbia technical insertion Component Development: - Continue Government support and oversight of development of over 101 engineered components - Continue qualification testing of prototype diesel generator for delivery to compatibility test facility for integration testing - Complete prototype manufacturing and commence critical qualification testing of the air conditioning unit - Complete ACRU qualification testing and restoration - Submit ACRU OPALT package for approval, and award contract for lead ship ACRU procurement - Continue operation of prototype ACRU at NSWC Philadelphia to gather reliability and performance data Propulsor and Shafting: - Complete full scale mechanical propulsor designs for fixed portion of propulsor. - Complete generation 2 propulsor LSV testing in support of fixed down-selection. - Complete final rotor hydrodynamic design - Down-select design for fixed portion of propulsor - Test candidate COLUMBIA Class propulsor bearing liner materials at the FSBTF - Facilitization efforts at NFPC will continue in FY19 and NFPC will continue manufacturing prototype demonstrations in FY2019 Shock, Structures and Composites: - Continue fabrication of combined shock and submergence scale models - Complete fabrication of the forward pressure hull confirmation model - Continue forward pressure hull need to repair procedures - Continue out-of-autoclave bow dome fabrication - Begin navigation sonar system window fabrication Signatures: - Continue to acquire and evaluate data from PIKE model testing with stern section - Complete fabrication of the forward structure on DOLLY VARDEN model and begin confirmation testing					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603595N / *(U)SSBN New Design*	**Project (Number/Name)** 3220 / *COLUMBIA Class Submarine Development*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Maneuvering, Ship Control and Hydrodynamic: - Deliver steering and diving, assisted ballast and trim, and anomaly detector algorithms to shipbuilder for incorporation into ship control software - Start developing CLB Submerged Operating Envelope by characterization of near-surface behavior for various sea states Funding profile was adjusted from PB19 budget values in FY18 and FY19 to align with refined estimates for prototyping					
FY 2020 Base Plans: This funding applies to the Government combat systems, component and technology development for the COLUMBIA submarine essential to achieving required survivability, combat and communications capabilities. Efforts planned in FY 2020 include: Combat Systems: - Complete revisions to any GFI required to support construction and continue to deliver remaining GFI - Execute non-recurring engineering development activities required for Columbia unique combat system components - Initiate AN/BRR-6 reliability based engineering changes - Deliver developmental Structurally Integrated Enclosures to combat systems vendor sites - Initiate early environmental qualification testing of Government Furnished Equipment Component Development: - Continue Government support and oversight of development of the approximately 43 of 101 remaining engineered components - Support diesel generator at compatibility test facility for integration testing - Complete critical qualification testing for the air conditioning unit, commence COLUMBIA production unit build, and install ACRU OPALT Propulsor and Shafting:					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603595N / *(U)SSBN New Design*	**Project (Number/Name)** 3220 / *COLUMBIA Class Submarine 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 down-select for the rotating portion of the propulsor after completing LSV testing and associated analysis - Begin reconfiguration of the FSBTF and installation of a propulsor bearing engineering demonstration model - Complete facilitization at NFPC Shock, Structures and Composites: - Complete Out of Autoclave bow dome fabrication and inspection - Continue navigation sonar system window fabrication Signatures: - Continue evaluation of data from PIKE model testing with stern section and update models as appropriate - Complete confirmation testing of the forward area design on DOLLY VARDEN and continue analysis of data - Continue to acquire DOLLY VARDEN and Anochoic Flow Facility Data as needed to support updates to Flow Source Acoustic Model - Support Shipbuilder qualification testing of machinery components and devices Maneuvering, Ship Control and Hydrodynamic: - Continue developing CLB Submerged Operating Envelope by characterization of near-surface behavior for various sea states ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Overall efforts transitioning to Detailed Design and construction efforts.					
Title: Systems Engineering/Program Management	57.279	57.986	54.965	0.000	54.965
Articles:	-	-	-	-	-
FY 2019 Plans: The Program will release the Construction Request for Proposal (RFP) in the first half of the year and conduct efforts throughout the year in preparation for the Critical Design Review (CDR) set for FY20. Other efforts include: - Program Office continued efforts to manage, coordinate, and oversee all effort of the program including shipbuilder and government activities					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603595N / *(U)SSBN New Design*	**Project (Number/Name)** 3220 / *COLUMBIA Class Submarine Development*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
- Management of Sonar, Combat, (Imaging System) COTS in support of FY 2020 COTS DSSM testing at Naval Surface Warfare Center Philadelphia - Leveraging ongoing sea-testing by other programs, COLUMBIA Survivability M&S maturation will continue at NUWC with the objective of assuring that the suite will support accreditation by COMOPTEVFOR before Initial Operational Test and Evaluation in FY2028 - Test the COLUMBIA Class Shock Isolated Deck high capacity mounts and fluid viscous dampers as part of the COLUMBIA LFT&E program - Complete and validate the USS COLUMIBA (SSBN 826) Program Validated Online Lifecycle Threat (VOLT) report - Complete the Joint COLUMBIA Class and VIRGINIA Class SWFTS TI-16 Cybersecurity Early Developmental Test (EDT) 18-1 test event by the National Cyber Range (NCR) and the NAVSEA Red Team - The COLUMBIA Class Program Office will continue to report on results of developmental testing being conducted to DD(DT&E) in accordance with the TEMP - Delivery of approximately 7 percent of all ILS products - Cyber Risk assessments to support continual cyber security development - Early Strategic Program System Integration into NPES Systems - Development of COLUMBIA Electronics Integration Plan to support shore side Command and Control integration and test, and execution of integration risk mitigations as identified by the IWG - Continue multi-year GAIUS to determine CLB unique maintenance facility requirements for Trident Refit Facilities - Continue non-MILCON studies and preparations at affected shore facilities, such as Utility and Mooring assessments - Receive stakeholder concurrence on maintenance product development processes, including roles and responsibilities ultimately resulting in an approved Class Maintenance Plan to support Lead Ship Delivery					
FY 2020 Base Plans: Continue Program Management and System Engineering activities including: - Program Office continued efforts to manage, coordinate, and oversee all effort of the program including shipbuilder and government activities - The NPES division of the program office management staff will apply resources to obtain technical support from government laboratories and sub-system Participating Area Managers (PARMs) to begin detailed design of the SSBN827 TI-24 NPES configuration					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
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B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
- Engineering rigor will be applied across all systems engineering disciplines to validate that the design of the TI-24 COATS configuration can be retrofit on lead ship during PSA with acceptable risk - The COLUMBIA LFT&E program will conduct COTS fragility testing of Sonar, Combat, and Imaging (and potentially SWS) components on the DSSM - HCM testing will be conducted if it was not completed in FY20 - Maturation of COLUMBIA survivability M&S and reporting of developmental test results will continue at NUWC Newport to support COMOPTEVFOR accreditation before Initial Operational Test and Evaluation (IOT&E) in FY 2028 - Continue multi-year GAIUS to determine CLB unique maintenance facility requirements for Trident Refit Facilities -Continue non-MILCON studies and preparations at affected shore facilities - Delivery of approximately 20 percent of all ILS products will be expected ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Overall efforts transitioning to Detailed Design and construction efforts.					
Title: Strategic Weapons Systems Integration	178.874	119.190	55.298	0.000	55.298
Articles:	-	-	-	-	-
FY 2019 Plans: - Continuing system engineering efforts required for the re-hosting and integration of the TRIDENT II (D5) SWS on the COLUMBIA submarine including review and modification of SWS Coordination, Interface and Arrangement Drawings for SWS equipment within the CMC and performing associated Logistic Support activities - Complete launcher evaluation and qualification testing at the LTF - Commence full utilization of the SWS Fire Control and Navigation Engineering Test Systems within the land-based test berths / facilities for SWS Subsystem hardware and software integration, verification and validation - Continue development of special test vehicles and SWS Ashore test capability development - Continue SWS training capability/requirements development - Continue systems engineering design related to the COLUMBIA guidance handling cart - Conduct a Missile system Critical Verification Review (CVR) - Conduct Production Readiness Reviews for SWS Launcher components and SWS Fire Control and Navigation Subsystems					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603595N / *(U)SSBN New Design*	**Project (Number/Name)** 3220 / *COLUMBIA Class Submarine Development*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
- Continue Reentry Body Simulator pre-production activities - Continue efforts of the Integration Working Group for the integration of NPES with the SWS ***FY 2020 Base Plans:*** - Continuing system engineering efforts required for the re-hosting and integration of the TRIDENT II (D5) SWS on the COLUMBIA submarine including review, modification and update of SWS Coordination, Interface and Arrangement Drawings for SWS equipment within the CMC and performing associated Logistic Support activities - Complete the launcher qualification report - Continue utilization of the SWS Fire Control and Navigation Engineering Test Systems within the land-based test berths / facilities for SWS Subsystem hardware and software integration, verification and validation - Continue development of special test vehicles - Complete installation of the COLUMBIA Launch Tube at SWS Ashore and achieve COLUMBIA configuration Initial Operating Capability (IOC) - Commence Strategic Weapon Support Systems (SWSS) Verification and Validation (V&V) testing at SWS Ashore - Conduct SWS Training System-level CDR involving both the SWS Fire Control and Navigation Subsystems - Conduct Strategic Weapon Training System (SWTS) Preliminary Design Review (PDR) - Deliver a Guidance Handling Cart prototype to SWS Ashore - Conduct Production Readiness Reviews for SWS Launcher, Fire Control and Guidance Subsystems - Conduct Navigation Software Qualification Test, Pre-Production performance testing and Navigation Trainer Production Readiness Review - Deliver Reentry Body Simulator Assemblies - Continue efforts of the Integration Working Group for the integration of NPES with the SWS - The FY 2020 funding request was reduced by $(2.500) million to account for the availability of prior year execution balances ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Overall efforts transitioning to Detailed Design and construction efforts.					
Accomplishments/Planned Programs Subtotals	751.497	514.846	419.051	0.000	419.051

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
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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
• RDTEN/0603570N/3219: *SBSD Nuclear Technology Development*	265.462	190.100	114.006	-	114.006	80.085	60.142	56.841	54.400	Continuing	Continuing
• RDTEN/0101221N/0951: *Joint Warhead Fuze Sustainment Program*	108.199	62.203	23.226	-	23.226	25.100	2.227	0.000	0.000	0.000	725.069
• OPN/5358: *Strategic Missile Systems Equip*	238.675	256.817	280.510	-	280.510	241.396	254.053	259.020	264.201	0.000	3,189.691
• WPN/1250: *TRIDENT II Mods*	1,131.910	1,056.750	0.000	1,177.251	1,177.251	1,215.624	1,204.762	1,288.753	1,318.818	3,215.106	26,124.279
• OMN/1D2D: *Fleet Ballistic Missile*	1,273.184	1,361.516	1,423.339	-	1,423.339	1,403.796	1,451.154	1,468.150	1,507.360	0.000	11,129.594
• SCN/1045: *COLUMBIA Class Submarine*	861.853	3,173.400	1,698.907	-	1,698.907	3,921.212	4,196.024	3,871.536	4,789.491	85,685.907	108,971.468
• MCN/32414106: *Submarine Propulsor Manufacturing Support Facility*	0.000	30.243	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	30.243
• MCN/64482044: *MCON Design*	2.416	0.000	0.006	-	0.006	1.309	1.310	0.000	1.410	0.000	6.451
• MCN/42237676: *Trident Training Facility Phase I*	0.000	0.000	0.000	-	0.000	0.000	0.000	31.500	0.000	0.000	31.500

Remarks

D. Acquisition Strategy

The Common Missile Compartment (CMC) is designed and developed to support the U.S. and UK in development of the COLUMBIA and DREADNOUGHT SSBN programs enabling a common U.S.-UK CMC and maximizing the benefit of the ongoing U.S.-UK partnership in strategic deterrence. The COLUMBIA Class Program RDT&E efforts will incentivize cost reduction initiatives in the design, construction and operations & support portions of the program. RDT&E efforts will be performed by Navy laboratories, shipyards, private industry, and University Affiliated Research Centers.

E. Performance Metrics

Updated Integrated Master Schedule and CMC build strategy down-select. Development of signature management efforts to address knowledge gap, concepts for propulsor and shafting, and design guidance and interface control requirements.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
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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	SS/CPFF	Ship Design Contractor-EB : Groton, CT	1,173.417	274.315	Oct 2017	165.730	Oct 2018	155.121	Oct 2019	-		155.121	Continuing	Continuing	Continuing
Product Development	WR	NSWC : Carderock, MD	388.351	96.117	Oct 2017	76.397	Oct 2018	69.465	Oct 2019	-		69.465	Continuing	Continuing	Continuing
Product Development	WR	NSWC : Philadelphia, PA	27.142	31.791	Oct 2017	24.276	Oct 2018	22.580	Oct 2019	-		22.580	0.000	105.789	-
Product Development	WR	NUWC : Newport, RI	55.823	23.270	Oct 2017	28.014	Oct 2018	32.129	Oct 2019	-		32.129	Continuing	Continuing	Continuing
Product Development	Various	NAVSEA : Various	99.920	89.852	Oct 2017	43.253	Oct 2018	29.493	Oct 2019	-		29.493	Continuing	Continuing	Continuing
Product Development	SS/CPFF	ARL Penn State University : State College, PA	1.361	0.900	Oct 2017	0.950	Oct 2018	1.300	Oct 2019	-		1.300	Continuing	Continuing	Continuing
Product Development	SS/CPFF	NGMS : Sunnyvale, CA	134.236	37.552	Oct 2017	16.551	Oct 2018	3.526	Oct 2019	-		3.526	Continuing	Continuing	Continuing
Product Development	SS/CPFF	JHU/APL : Laurel, MD	14.498	5.598	Jan 2018	5.310	Jan 2019	2.582	Jan 2020	-		2.582	Continuing	Continuing	Continuing
Product Development	WR	NUWC : Keyport, WA	0.652	0.000	Oct 2017	0.000	Oct 2018	0.000		-		0.000	Continuing	Continuing	Continuing
Product Development	SS/CPFF	CSDL : Cambridge, MA	9.081	0.857	Oct 2017	0.230	Oct 2018	0.069	Oct 2019	-		0.069	Continuing	Continuing	Continuing
Product Development	SS/CPFF	LMRMS : Mitchel Field, NY	49.807	21.572	Dec 2017	14.031	Oct 2018	4.176	Oct 2019	-		4.176	Continuing	Continuing	Continuing
Product Development	C/CPFF	EMCUBE : Alexandria, VA	2.359	0.840	Oct 2017	0.492	Oct 2018	0.221	Oct 2019	-		0.221	Continuing	Continuing	Continuing
Product Development	SS/CPFF	LMMSC : Sunnyvale, CA	75.250	20.052	Oct 2017	14.092	Feb 2019	4.260	Feb 2020	-		4.260	Continuing	Continuing	Continuing
Product Development	SS/CPFF	JRC : Washington, DC	2.996	0.521	Oct 2017	1.952	Oct 2018	0.836	Oct 2019	-		0.836	Continuing	Continuing	Continuing
Product Development	C/CPFF	GDMS : Pittsfield, MA	94.333	33.848	Nov 2017	13.877	Nov 2018	4.387	Nov 2019	-		4.387	Continuing	Continuing	Continuing
Product Development	WR	CNSW : China Lake, CA	49.729	19.972	Nov 2017	17.879	Nov 2018	14.562	Nov 2019	-		14.562	Continuing	Continuing	Continuing

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603595N / *(U)SSBN New Design*	**Project (Number/Name)** 3220 / *COLUMBIA Class Submarine 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	SS/CPFF	IEC : Anaheim, CA	2.869	0.450	Oct 2017	0.430	Oct 2018	0.209	Oct 2019	-		0.209	Continuing	Continuing	Continuing
Product Development	WR	NSWC : Dahlgren, VA	13.135	7.559	Oct 2017	7.675	Oct 2018	5.036	Oct 2019	-		5.036	Continuing	Continuing	Continuing
Product Development	SS/CPFF	BAE : Rockville, MD	27.815	8.925	Oct 2017	6.612	Oct 2018	2.880	Oct 2019	-		2.880	Continuing	Continuing	Continuing
Product Development	SS/CPFF	BNA : Huntington Beach, CA	3.217	0.000	Oct 2017	0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Product Development	WR	NSWC Crane : Crane, IN	44.072	10.041	Nov 2017	9.071	Nov 2018	7.914	Nov 2019	-		7.914	Continuing	Continuing	Continuing
Product Development	SS/CPFF	GDEB : Groton, CT	0.000	4.670	Oct 2017	2.192	Oct 2018	0.436	Oct 2019	-		0.436	0.000	7.298	-
Product Development	Various	SSP : Various	11.568	3.778	Oct 2017	6.158	Oct 2018	2.145	Oct 2019	-		2.145	Continuing	Continuing	Continuing
Product Development	SS/CPFF	SPA : Alexandria, VA	8.132	1.739	Oct 2017	1.688	Oct 2018	0.759	Oct 2019	-		0.759	Continuing	Continuing	Continuing
		Subtotal	2,289.763	694.219		456.860		364.086		-		364.086	Continuing	Continuing	N/A

Remarks

The funding values in FY18 and FY19 was adjusted from PB19 budget values in order to properly align the execution of funding within Product Development. The overall funding requirement has not increased and there is no cost growth.

Increased funding from FY19 to FY20 at NUWC Newport reflects increased efforts related to the Columbia Class Common Submarine Radio Room and Submarine Communication Antenna technical design.

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
Contractor Management Support	C/CPFF	Various : Multiple Awards	72.167	30.758	Nov 2017	31.066	Nov 2018	30.043	Nov 2019	-		30.043	Continuing	Continuing	Continuing
Government Management Support	WR	Various: NSWC : Carderock, MD	52.324	15.725	Oct 2017	15.959	Oct 2018	16.102	Oct 2019	-		16.102	Continuing	Continuing	Continuing
Government Management Support	WR	Various: NSWC : Philadelphia, PA	3.240	3.289	Oct 2017	3.338	Oct 2018	3.257	Oct 2019	-		3.257	0.000	13.124	-
Government Management Support	WR	Various: NUWC : Newport, RI	5.034	5.109	Oct 2017	5.186	Oct 2018	4.911	Oct 2019	-		4.911	0.000	20.240	-

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603595N / *(U)SSBN New Design*	**Project (Number/Name)** 3220 / *COLUMBIA Class Submarine 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
Government Management Support	WR	Vairous: SUPSHIP : Groton, CT	1.744	1.770	Oct 2017	1.797	Oct 2018	0.000		-		0.000	0.000	5.311	-
Travel	WR	NAVSEA HQ : Washington, D.C.	1.479	0.627	Nov 2017	0.640	Nov 2018	0.652	Nov 2019	-		0.652	Continuing	Continuing	Continuing
		Subtotal	135.988	57.278		57.986		54.965		-		54.965	Continuing	Continuing	N/A

Remarks

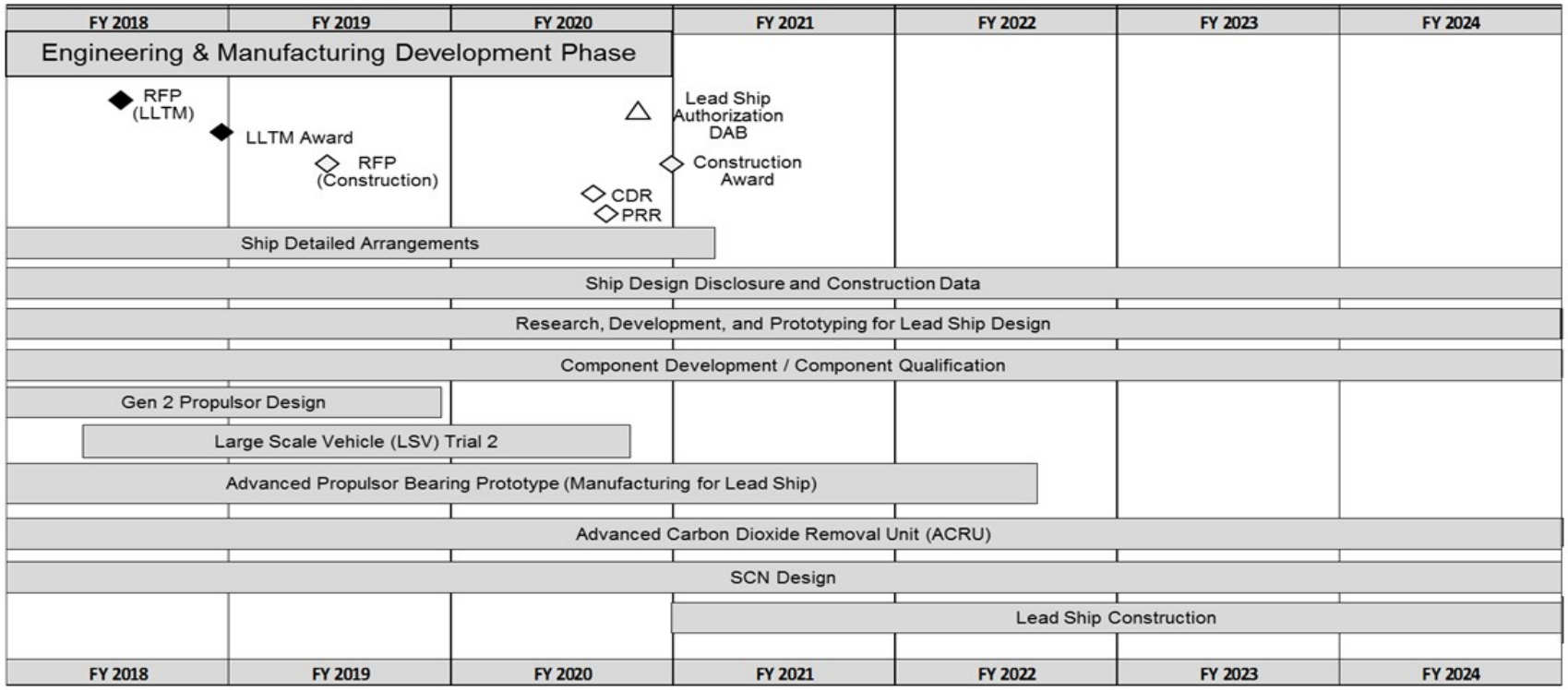
The program analyzed the Management Services which were originally planned in SCN beginning in FY17, and determined it was more appropriately funded with R&D through lead ship construction start in FY21. This submission reflects those changes for FY18 and FY19.

	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	2,425.751	751.497		514.846		419.051		-		419.051	Continuing	Continuing	N/A

Remarks

The listed Award Dates represent the date on which initial obligations occur for the effort.

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603595N / *(U)SSBN New Design*	**Project (Number/Name)** 3220 / *COLUMBIA Class Submarine Development*



CDD - Capabilities Development Document
CDR - Critical Design Review
CPD - Capability Production Document
DAB - Defense Acquisition Board
IPR - In Progress Review
JROC - Joint Requirements Oversight Council
LLTM - Long Lead Time Material
PDR - Preliminary Design Review
PRR – Production Readiness Review
RDT&E - Research, Development, Test, & Evaluation
RFP - Request for Proposal
SCN - Shipbuilding and Conversion, Navy
SRR - System Requirements Review

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603595N / *(U)SSBN New Design*	**Project (Number/Name)** 3220 / *COLUMBIA Class Submarine Development*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Notes: * Effort began prior to 1st Quarter FY 2018. ** Effort continues past 4th Quarter FY 2024				
Ship Detailed Arrangements*	1	2018	1	2021
Ship Design Disclosure and Construction Data*, **	1	2018	4	2024
Research, Development, and Prototyping for Lead Ship*, **	1	2018	4	2024
Component Development/Component Qualification* , **	1	2018	4	2024
Gen 2 Propulsor Design*, **	1	2018	4	2019
Large Scale Vehicle (LSV) Trials*	2	2018	4	2020
Advanced Propulsor Bearing Prototype (Manufacturing for Lead Ship)*	1	2018	3	2022
Advanced Carbon Dioxide Removal Unit (ACRU)*, **	1	2018	4	2024
SCN Design*, **	1	2018	4	2024
Lead Ship Construction**	1	2021	4	2024

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy											Date: March 2019	
Appropriation/Budget Activity 1319 / 4					R-1 Program Element (Number/Name) PE 0603595N / *(U)SSBN New Design*				Project (Number/Name) 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	24.127	28.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	52.127
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

FY18 Congressional Add supporting the development of composite materials for COLUMBIA Class Propulsion. FY19 Congressional Add supports the continued development of composite materials and also provides funding for the Naval Propulsion Foundry Center Facility Power Upgrades.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019
Congressional Add: Advanced Materials Propeller Program ***FY 2018 Accomplishments:*** This funding was used to design and fabricate composite Advanced Propulsor Bearing shaft components, Advanced Composite Control Surfaces, as well as composite CNC (Computer Numerical Controlled) machining and inspection/handling fixturing for propulsor components. This effort will build on the success of current efforts for composite propulsor ducts and tail cones, composite shafting and HYSHMA (Hydrodynamic Shaping Material) propulsion applications. ***FY 2019 Plans:*** Continue the design and fabrication of composite Advanced Propulsor Bearing shaft components, Advanced Composite Control Surfaces, as well as composite CNC machining and inspection/ handling fixturing for propulsor components.	24.127	15.000
Congressional Add: Naval Propulsion Foundry Center Facility Power Upgrades ***FY 2018 Accomplishments:*** N/A ***FY 2019 Plans:*** Complete initial Power/Utility upgrades, and support power/utility work and execute procurement of large, high speed milling machines contracted via Defense Logistics Agency (Aviation). These new machines will make use of the additional power provided to the Naval Foundry and Propeller Center (NFPC). Installation, acceptance and turnover to production for the machines will complete in early FY20.	0.000	13.000
Congressional Adds Subtotals	24.127	28.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603595N / *(U)SSBN New Design*	**Project (Number/Name)** 9999 / *Congressional Adds*

E. Performance Metrics

Development of concepts for the use of composite materials in submarine propulsor applications, including fixtures, hydrodynamic surfaces, and supporting structures.

Completion of power/utility and machine upgrades per schedule to support NFPC work.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603595N / *(U)SSBN New Design*	Project (Number/Name) 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	SS/CPFF	Seeman Composites : Gulfport, MS	0.000	1.171	Sep 2018	0.000		0.000		-		0.000	0.000	1.171	-
Product Development	TBD	Seeman Comp : Gulfport, MS	0.000	21.763	Jan 2019	10.138	Jun 2019	0.000		-		0.000	0.000	31.901	-
Product Devlopment	WR	NSWC : Carderock, MD	0.000	1.193	Jul 2018	4.862	Nov 2019	0.000		-		0.000	0.000	6.055	-
Product Development	C/FFP	DLA Aviation : Richmond, VA	0.000	0.000		13.000	Nov 2018	0.000		-		0.000	0.000	13.000	-
		Subtotal	0.000	24.127		28.000		0.000		-		0.000	0.000	52.127	N/A

Remarks

Seeman Composites follow on contract plan award date February 2019.

	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	24.127		28.000		0.000		-		0.000	0.000	52.127	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603595N / *(U)SSBN New Design*	**Project (Number/Name)** 9999 / *Congressional Adds*

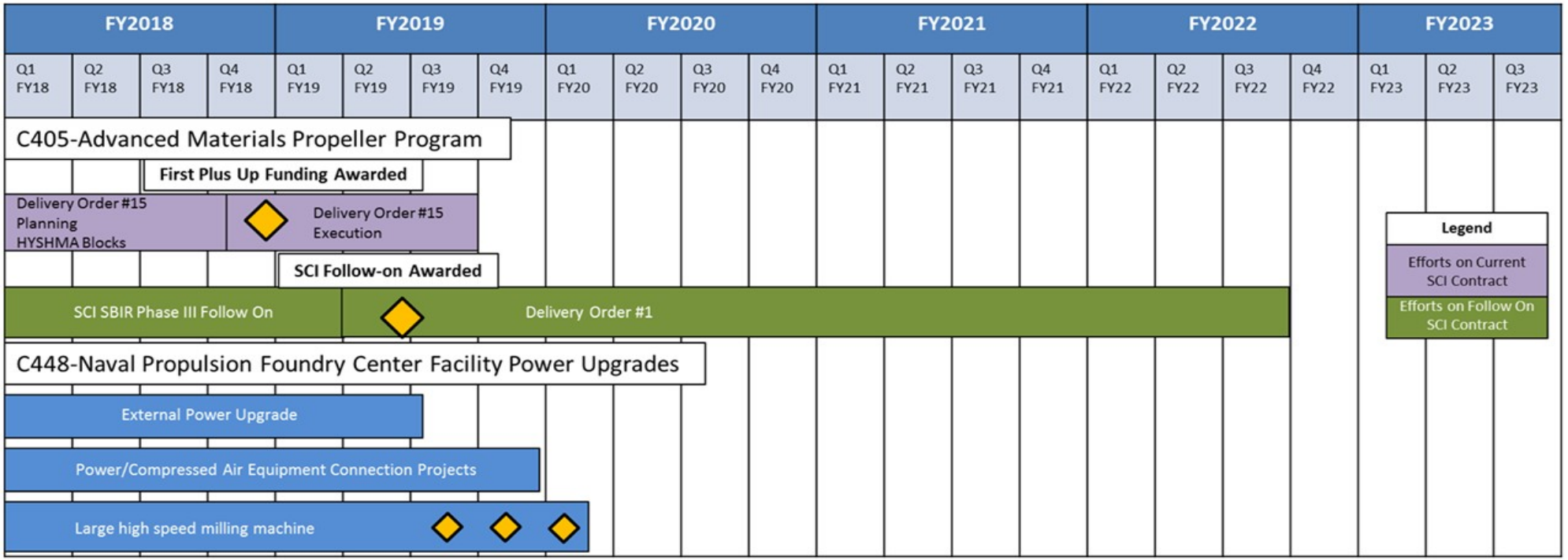


Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603595N / *(U)SSBN New Design*	**Project (Number/Name)** 9999 / *Congressional Adds*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Proj 9999				
Initial Award on Current Vehicle (Delivery Order #15)	4	2018	2	2019
Follow-On Award (Delivery Order #1)	2	2019	4	2022
External Power Upgrade	1	2018	3	2019
Power/Compressed Air Equipment Connection Projects	1	2018	4	2019
First large high speed milling machine	1	2018	3	2019
Second large high speed milling machine	1	2018	4	2019
Third large high speed milling machine	1	2018	1	2020