Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Navy											Date: February 2020	
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 0603562N *I Submarine Tactical Warfare Sys*							
COST ($ in Millions)	**Prior Years**	**FY 2019**	**FY 2020**	**FY 2021 Base**	**FY 2021 OCO**	**FY 2021 Total**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**	**Cost To Complete**	**Total Cost**
Total Program Element	95.621	12.180	11.192	10.528	-	10.528	14.291	11.926	12.157	12.398	Continuing	Continuing
0770: *Adv Sub Supp Equip Prog*	25.413	4.264	4.557	4.773	-	4.773	4.810	4.890	4.980	5.077	Continuing	Continuing
1739: *Submarine Arctic W/F Development*	70.208	5.022	6.635	5.755	-	5.755	9.481	7.036	7.177	7.321	Continuing	Continuing
9999: *Congressional Adds*	0.000	2.894	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.894

A. Mission Description and Budget Item Justification

This Program Element (PE) addresses advanced submarine technology areas in support of the Navy's strategic objective of Assured Access and Combat Credibility. All projects funded in this PE are non-Acquisition Category (ACAT) programs.

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

PROJECT 1739 - The Submarine Arctic Warfare Development Project is aligned to Commander, Undersea Warfighting Development Center (UWDC), Detachment Arctic Submarine Laboratory (ASL). This Project provides the U.S. Navy Submarine Force (SUBFOR) a cadre of trained Arctic Operation Specialists (AOS) and an inventory of unique Arctic sensors that are installed to optimize submarine safety during under-ice operations. AOS personnel assigned from ASL embark on submarines that deploy to the Arctic, cold water and iceberg regions, and marginal ice zones (MIZ) in northern latitudes of the Atlantic and Pacific Oceans, and are advisers to the Commanding Officer. ASL is a shore facility at Naval Base Point Loma with the infrastructure capable of supporting personnel and equipment to conduct the submarine Arctic Warfare Development mission. Improvements and life-cycle expenditures to the facility and warehousing are made as necessary to support the mission.

The Submarine Arctic Warfare Development Project, via ASL, responds to the increased threat of naval activity in the Arctic regions while continuously supporting the Navy's strategic objective of Assured Access and Combat Credibility. ASL provides a unique capability that enables the submarine force to satisfy the requirements laid out in the Arctic Maritime Homeland Defense Initial Capabilities Document (ICD). ASL and SUBFOR demonstrate existing Arctic Warfare capabilities and operational and tactical proficiency while developing advanced submarine technology in unique cold water environments, in under-ice conditions, and in ice-covered shallow water regions during a biennial Ice Exercise (ICEX). ICEX places an emphasis on submarine operability and mission capability in the world's harshest maritime environment. Efforts include assessment of combat system effectiveness, weapons testing, use of High Frequency (HF) sonars in Arctic regions, testing of ice-capable submarine structures, and development of class-specific Arctic operational guidelines. Tactical Development (TACDEV) ICEXs are conducted biennially and require up front comprehensive planning and work-up training, as well as post exercise analysis and reporting. ICEXs provide the framework for various submarine test and

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Navy	Date: February 2020
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 0603562N *I Submarine Tactical Warfare Sys*

evaluation in Arctic regions and at periodic Ice Camps. This program represents DoD's only drifting ice station capability. Emphasis during ICEX is placed on the areas of sonar operability, tactical surveillance, weapon utility, and other submarine support missions. These efforts include the assessment of combat system effectiveness, development of Arctic specific improvements for existing sonar and weapons, development of class-specific Arctic operational guidelines, and testing of ice-capable submarine support structures.

A torpedo firing ICEX occurs every four (4) years (FY2018, FY2022, etc.) in order to meet minimum Fleet requirements of exercise torpedo (EXTORP) firings in the Arctic. A Torpedo Exercise (TORPEX) requires a significantly higher level of logistics, personnel, and infrastructure to account for the recovery and transportation efforts of the EXTORPs.

B. Program Change Summary ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	12.374	11.192	11.481	-	11.481
Current President's Budget	12.180	11.192	10.528	-	10.528
Total Adjustments	-0.194	0.000	-0.953	-	-0.953
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.194	0.000			
• Program Adjustments	0.000	0.000	-1.000	-	-1.000
• Rate/Misc Adjustments	0.000	0.000	0.047	-	0.047

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2019	FY 2020
Project: 9999: *Congressional Adds*		
Congressional Add: *Advanced Submarine Electronic Warfare Systems*	2.894	0.000
Congressional Add Subtotals for Project: 9999	2.894	0.000
Congressional Add Totals for all Projects	2.894	0.000

Change Summary Explanation

FUNDING CHANGES SINCE THE PREVIOUS PRESIDENT'S BUDGET AT THE OVERALL PE LEVEL:
- FY 2019 decrease of $-0.194M reflects Small Business Innovative Research (SBIR) transfer.

- FY 2021 decrease of $-0.953M reflects realignment of Project 1739 funding ($-1.000M) from FY 2021 to FY 2022 to properly support contract expenditure for the preparation year to conduct torpedo firing exercises and incorporation of general and Navy Working Capital Fund (NWCF) specific rate adjustments ($ +0.047M).

PROJECT 0770 - FY 2020 TO FY 2021 BUDGET REQUEST INCREASE:
- FY 2020 ($4.557M) to FY 2021 ($4.773M) increase ($+0.216M) is in line with the inflation associated with the RDT&EN appropriation.

PROJECT 1739 - FY 2020 to FY 2021 BUDGET REQUEST DECREASE:
- FY 2020 ($6.635M) to FY 2021 ($5.755M) decrease ($-0.880M) is driven by FY 2021 being an ICEX planning year (no major ICEX/Ice Camp events scheduled in FY 2021).

SCHEDULE CHANGES SINCE THE PREVIOUS PRESIDENT'S BUDGET:
PROJECT 0770 - In an effort to reduce the number of individual efforts depicted on the R-4, the schedule for FY 2021 President's Budget Request has since been streamlined to only show the most significant development items. All other efforts previously shown on the FY 2020 President's Budget request R-4, and no longer depicted on the schedule for FY 2021 President's Budget Request, are still planned to occur as previously shown.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603562N / *Submarine Tactical Warfare Sys*	Project (Number/Name) 0770 / *Adv Sub Supp Equip Prog*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
0770: *Adv Sub Supp Equip Prog*	25.413	4.264	4.557	4.773	-	4.773	4.810	4.890	4.980	5.077	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

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

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

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: Advanced Imaging Project Development	2.518	2.279	2.386	0.000	2.386
Articles:	-	-	-	-	-
FY 2020 Plans:					
- Complete Sea Test and Continue Meteorological Sensors Development.					
- Complete Low Power Fiber Delivered Laser Range Finder and Transition to Imaging.					
- Complete Reduced Cost Fabrication of Optical Sapphire Hyper-hemispheres and Transition to Imaging.					
- Complete Anti-Reflective Coating Spherical Domes Test and Continue Development.					
- Complete Volumetric Atmospheric Modeling Testing and Continue Development.					
- Complete Near Ocean Imaging through Atmospheric Turbulence Testing and Continue Development.					
- Complete Vulnerability Improvement Testing and Continue Development.					
- Start Imaging Buoy Development.					
- Continue System for Non-Acoustic Control of Signatures Development.					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
- Complete Electromagnetic Spectrum Sensor System Simulation & Development for Model-Based Mission Planning Test and Transition to Imaging. ***FY 2021 Base Plans:*** - Complete Meteorological Sensors Development and Transition to Imaging. - Complete Development of Anti-Reflective Coating Spherical Domes and Transition to Imaging. - Complete Development of Volumetric Atmospheric Modeling and Transition to Imaging. - Continue Development of Near Ocean Imaging Through Atmospheric Turbulence. - Continue Development and Testing of Vulnerability Improvement. - Continue Imaging Buoy Development and Testing. - Continue System for Non-Acoustic Control of Signatures Development. - Transition Electromagnetic Spectrum Sensor System Simulation & Development for Model - Based Mission Planning. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** - FY 2020 ($2.279M) to FY 2021 ($2.386M) increase ($+0.107M) is in line with inflation associated with the RDT&EN appropriation.					
Title: Advanced Electronic Warfare (EW) Project Development	1.746	2.278	2.387	0.000	2.387
Articles:	-	-	-	-	-
FY 2020 Plans: - Complete Lab Test and Transition Solid State RADAR Emitter Identification to Electronic Warfare (EW). - Complete Extremely Wideband Digital Receiver Lab Test and Transition to EW. - Continue Tunable Optical Filters for RF Photonic Signal Distributions System Lab Test #2. - Commence Data Transmission using VLC for Undersea Platforms Lab Test. - Commence Ruggedized High Speed Optical Fiber Network Connector Interfaces for NEXGEN EW Lab Test. - Complete Technical Insertion-22 (TI-22) Disposable Buoys Modular Expendable Decoy Buoy Enhancement and Transition to EW. - Complete TI-22 Disposable Buoys Modular Expendable ISR Buoy and Transition to EW. - Complete TI Tethered Buoys Modular Tethered Antennas and RF Over Fiber and Transition to EW. - Complete Micro Adaptive Training Lab Test. - Complete Mast Antenna Coupler Lab Test.					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
- Start RADAR Vulnerability Assessment Tool (RVAT) Development and complete Step 2 and 3 Test. - Start Virginia Class Submarine Direction Finding (VA DF) Improvement Development and complete Step 2 and 3 Test. - Start Low Probability of Intercept (LPI) RADAR improvement and complete Step 2 and 3 Test. ***FY 2021 Base Plans:*** - Transition Solid State RADAR Emitter Identification to EW. - Continue Tunable Optical Filters for Radio Frequency Photonic Signal Distributions System Lab Test. - Complete Data Transmission using Visible Light Comms for Undersea Platforms Lab Test. - Complete Ruggedized High Speed Optical Fiber Network Connector Interfaces for NEXGEN EW. - Complete Micro Adaptive Training and prepare for transition to EW. - Complete Mast Antenna Coupler Lab Test #2 and prepare for transition to EW. - Continue RADAR Vulnerability Assessment Tool Development. - Continue to develop Virginia Class Submarine Direction Finding Improvement Development. - Continue to develop LPI RADAR improvement. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** - FY 2020 ($2.278M) to FY 2021 ($2.387M) increase ($+0.109M) is in line with inflation associated with the RDT&EN appropriation.					
Accomplishments/Planned Programs Subtotals	4.264	4.557	4.773	0.000	4.773

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

- This project is a non-Acquisition Category (ACAT) program.
- This project optimizes technology insertion using a build-test-build approach to support EW and Imaging operational needs. Operational needs have been based on the tactical requirements identified in the Common Submarine Imaging System (CSIS) (CDD# 849-87-11) dated 22 Dec 2011, with an updated CDD approved on 15 Mar 2018, for Submarine Imaging Systems, and the Common Submarine Electronic Warfare System (CSEWS) (CDD# 907-97-16) dated 27 Sep 2016 for the Electronic Warfare Systems. Project efforts develop submarine unique improvements to mast, periscope, and EW electromagnetic spectrum and electro-optic sensors based

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

on emerging technologies that are available from DoD Exploratory Development Programs, industry Independent Research and Development, and other sources. Engineering Development Models (EDMs) will be developed to provide a realistic method of evaluating the improvements, including deployment on submarines for testing.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Advanced Imaging and EW - Systems Engineering	WR	NUWC : RI	24.466	4.236	Nov 2018	1.541	Nov 2019	1.685	Nov 2020	-		1.685	Continuing	Continuing	Continuing
Advanced Imaging and EW - Software and Hardware Development	C/FP	JHU/APL : MD	0.000	0.000	Nov 2018	2.278	Nov 2019	2.325	Nov 2020	-		2.325	Continuing	Continuing	Continuing
Advanced Imaging and EW - Software and Hardware Development	MIPR	MIT/LL : MA	0.590	0.000	Nov 2018	0.710	Nov 2019	0.735	Dec 2020	-		0.735	Continuing	Continuing	Continuing
		Subtotal	25.056	4.236		4.529		4.745		-		4.745	Continuing	Continuing	N/A

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Program Office Travel	WR	NAVSEA : DC	0.357	0.028	Nov 2018	0.028	Jan 2020	0.028	Nov 2020	-		0.028	Continuing	Continuing	Continuing
		Subtotal	0.357	0.028		0.028		0.028		-		0.028	Continuing	Continuing	N/A

	Prior Years	FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	25.413	4.264		4.557		4.773		-		4.773	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

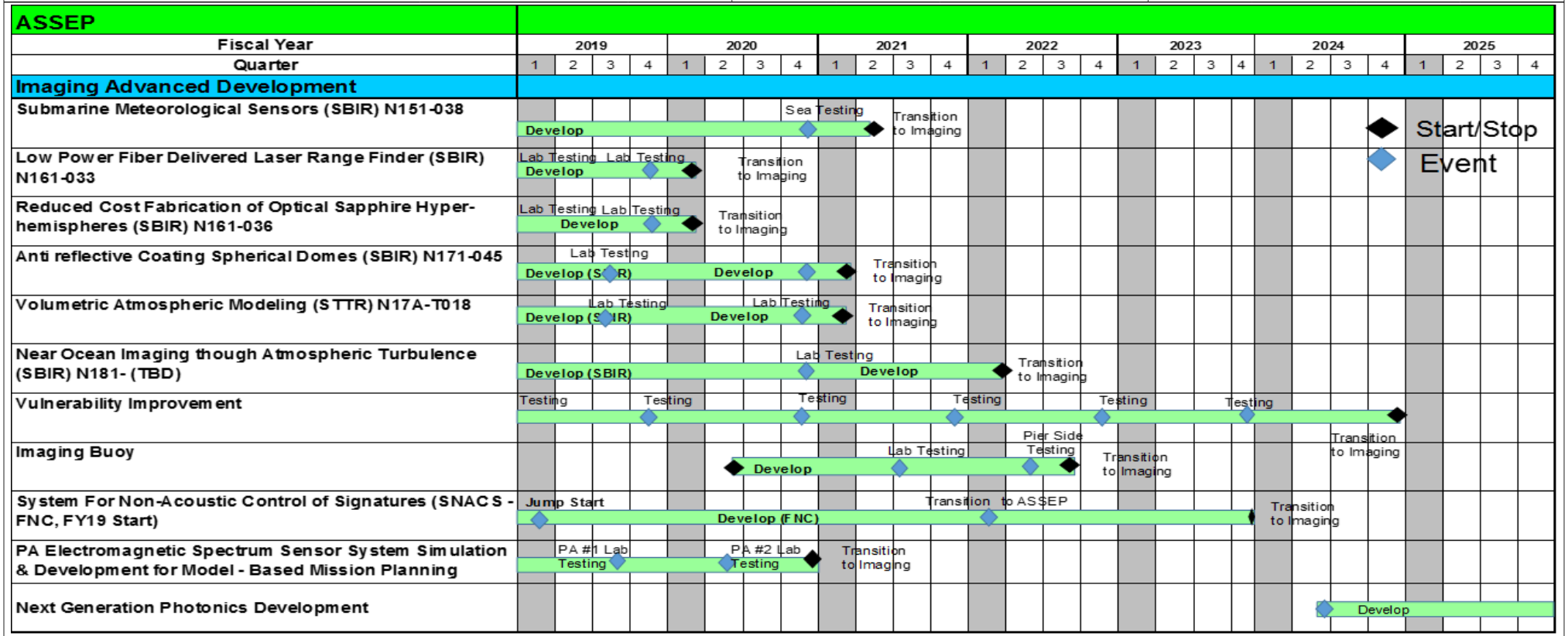

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

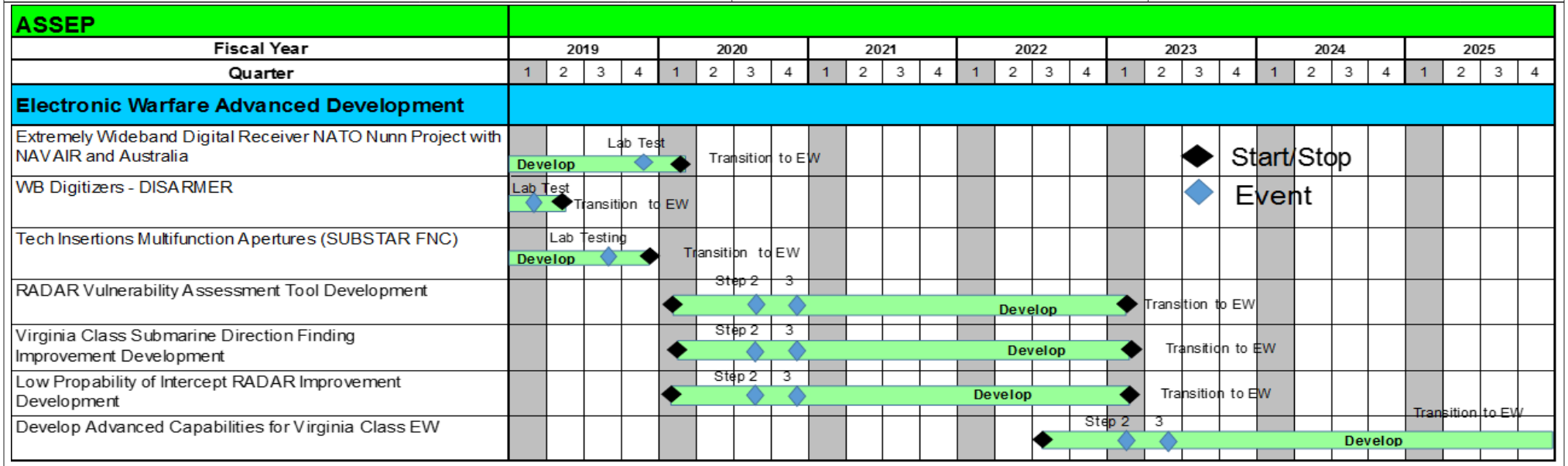

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Imaging Advanced Development				
Submarine Meteorological Sensors - Development	1	2019	2	2021
Submarine Meteorological Sensors - Sea Test	4	2020	4	2020
Submarine Meteorological Sensors - Transition to Imaging	2	2021	2	2021
Low Power Fiber Delivered Laser Range Finder - Development	1	2019	1	2020
Low Power Fiber Delivered Laser Range Finder - Lab Test	4	2019	4	2019
Low Power Fiber Delivered Laser Range Finder - Transition to Imaging	1	2020	1	2020
Reduced Cost Fabrication of Optical Sapphire Hyper-hemispheres - Development	1	2019	1	2020
Reduced Cost Fabrication of Optical Sapphire Hyper-hemispheres - Lab Test	4	2019	4	2019
Reduced Cost Fabrication of Optical Sapphire Hyper-hemispheres - Transition to Imaging	1	2020	1	2020
Anti-reflective Coating Spherical Domes - Development	1	2019	1	2021
Anti-reflective Coating Spherical Domes - Lab Test #1	3	2019	3	2019
Anti-reflective Coating Spherical Domes - Lab Test #2	4	2020	4	2020
Anti-reflective Coating Spherical Domes - Transition to Imaging	1	2021	1	2021
Volumetric Atmospheric Modeling (STTR) - Development	1	2019	1	2021
Volumetric Atmospheric Modeling (STTR) - Lab Test #1	3	2019	3	2019
Volumetric Atmospheric Modeling (STTR) - Lab Test #2	4	2020	4	2020
Volumetric Atmospheric Modeling (STTR) - Transition to Imaging	1	2021	1	2021
Near Ocean Imaging though Atmospheric Turbulence - Development	1	2019	1	2022
Near Ocean Imaging though Atmospheric Turbulence - Lab Test	4	2020	4	2020
Near Ocean Imaging though Atmospheric Turbulence - Transition to Imaging	1	2022	1	2022

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Vulnerability Improvement - Development	1	2019	4	2024
Vulnerability Improvement - Lab Test #1	4	2019	4	2019
Vulnerability Improvement - Lab Test #2	4	2020	4	2020
Vulnerability Improvement - Lab Test #3	4	2021	4	2021
Vulnerability Improvement - Lab Test #4	4	2022	4	2022
Vulnerability Improvement - Lab Test #5	4	2023	4	2023
Vulnerability Improvement - Transition to Imaging	4	2024	4	2024
Imaging Buoy - Development	2	2020	3	2022
Imaging Buoy - Lab Test	3	2021	3	2021
Imaging Buoy - Pierside Test	2	2022	2	2022
Imaging Buoy - Transition to Imaging	3	2022	3	2022
SNACS - Development	1	2019	4	2023
SNACS - Jump Start	1	2019	1	2019
SNACS - Transition to ASSEP	1	2022	1	2022
SNACS - Transition to Imaging	4	2023	4	2023
PA Electromagnetic Spectrum Sensor System Simulation & Dev for Model - Development	1	2019	4	2020
PA Electromagnetic Spectrum Sensor System Simulation & Dev for Model - PA Lab Testing #1	3	2019	3	2019
PA Electromagnetic Spectrum Sensor System Simulation & Dev for Model - PA Lab Testing #2	2	2020	2	2020
PA Electromagnetic Spectrum Sensor System Simulation & Dev for Model - Based Mission Planning - Transition to Imaging	4	2020	4	2020
Next Generation Photonics Development	2	2024	4	2025
Electronic Warfare Advanced Development				
Extremely Wideband Digital Receiver NATO Nunn Project with NAVAIR and Australia Development	1	2019	1	2020

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Extremely Wideband Digital Receiver NATO Nunn Project with NAVAIR and Australia Lab Test	4	2019	4	2019
Extremely Wideband Digital Receiver NATO Nunn Project with NAVAIR and Australia Transition to EW	1	2020	1	2020
WB Digitizers - DISARMER Development	1	2019	2	2019
WB Digitizers - DISARMER Lab Test	1	2019	1	2019
WB Digitizers - DISARMER Transition to EW	2	2019	2	2019
TI Multifunctional Apertures Development	1	2019	4	2019
TI Multifunctional Apertures Lab Test	3	2019	3	2019
TI Multifunctional Apertures Transition to EW	4	2019	4	2019
RADAR Vulnerability Assessment Tool Development	1	2020	1	2023
RADAR Vulnerability Assessment Tool Step 2 Test	3	2020	3	2020
RADAR Vulnerability Assessment Tool Step 3 Test	4	2020	4	2020
RADAR Vulnerability Assessment Tool Development Transition to EW	1	2023	1	2023
Virginia Class Submarine Direction Finding Improvement Development	1	2020	1	2023
Virginia Class Submarine Direction Finding Improvement Step 2 Test	3	2020	3	2020
Virginia Class Submarine Direction Finding Improvement Step 3 Test	4	2020	4	2020
Virginia Class Submarine Direction Finding Improvement Transition to EW	1	2023	1	2023
Low Probability of Intercept RADAR Improvement Development	1	2020	1	2023
Low Probability of Intercept RADAR Improvement Step 2 Test	3	2020	3	2020
Low Probability of Intercept RADAR Improvement Step 3 Test	4	2020	4	2020
Low Probability of Intercept RADAR Improvement Test Transition to EW	1	2023	1	2023
Develop Advanced Capabilities for Virginia Class EW	3	2022	4	2025
Develop Advanced Capabilities for Virginia Class EW - Step 2 Test	1	2023	1	2023
Develop Advanced Capabilities for Virginia Class EW - Step 3 Test	2	2023	2	2023

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603562N / *Submarine Tactical Warfare Sys*	Project (Number/Name) 1739 / *Submarine Arctic W/F Development*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
1739: *Submarine Arctic W/F Development*	70.208	5.022	6.635	5.755	-	5.755	9.481	7.036	7.177	7.321	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Submarine Arctic Warfare Development Project is aligned to Commander, Undersea Warfighting Development Center (UWDC), Detachment Arctic Submarine Laboratory (ASL). This Project provides the U.S. Navy Submarine Force (SUBFOR) a cadre of trained Arctic Operation Specialists (AOS) and an inventory of unique Arctic sensors that are installed to optimize submarine safety during under-ice operations. AOS personnel assigned from ASL embark on submarines that deploy to the Arctic, cold water and iceberg regions, and marginal ice zones (MIZ) in northern latitudes of the Atlantic and Pacific Oceans, and are advisers to the Commanding Officer. ASL is a shore facility at Naval Base Point Loma with the infrastructure capable of supporting personnel and equipment to conduct the submarine Arctic Warfare Development mission. Improvements and life-cycle expenditures to the facility and warehousing are made as necessary to support the mission.

The Submarine Arctic Warfare Development Project, via ASL, responds to the increased threat of naval activity in the Arctic regions while continuously supporting the Navy's strategic objective of Assured Access and Combat Credibility. ASL provides a unique capability that enables the submarine force to satisfy the requirements laid out in the Arctic Maritime Homeland Defense Initial Capabilities Document (ICD). ASL and SUBFOR demonstrate existing Arctic Warfare capabilities and operational and tactical proficiency while developing advanced submarine technology in unique cold water environments, in under-ice conditions, and in ice-covered shallow water regions during a biennial Ice Exercise (ICEX). ICEX places an emphasis on submarine operability and mission capability in the world's harshest maritime environment. Efforts include assessment of combat system effectiveness, weapons testing, use of High Frequency (HF) sonars in Arctic regions, testing of ice-capable submarine structures, and development of class-specific Arctic operational guidelines. Tactical Development (TACDEV) ICEXs are conducted biennially and require up front comprehensive planning and work-up training, as well as post exercise analysis and reporting. ICEXs provide the framework for various submarine test and evaluation in Arctic regions and at periodic Ice Camps. This program represents DoD's only drifting ice station capability. Emphasis during ICEX is placed on the areas of sonar operability, tactical surveillance, weapon utility, and other submarine support missions. These efforts include the assessment of combat system effectiveness, development of Arctic specific improvements for existing sonar and weapons, development of class-specific Arctic operational guidelines, and testing of ice-capable submarine support structures. Torpedo ICEXs, occurring every four (4) years (FY 2018, FY 2022, etc.) include a Fleet requirement to conduct exercise torpedo (EXTORP) firings in the Arctic. A Torpedo Exercise (TORPEX) requires a significantly higher level of logistics, personnel, and infrastructure to account for the recovery and transportation efforts of the EXTORPs.

All programs funded in this project are non-Acquisition Category (ACAT) programs.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: Conduct ICEX and Arctic Transit Mission, ICEX Workup and Training, Ice Camps	5.022	6.635	5.755	0.000	5.755
Articles:	-	-	-	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 1739 / *Submarine Arctic W/F Development*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
FY 2020 Plans: - Conduct Arctic work-up training, Ice Exercise (ICEX) mission 2020, and Ice Camp 2020. - Conduct ICEX 2020 as a Tactical Development (TACDEV) event. Operate a submarine tracking range for approximately 14 days, conduct complex and coordinated operations from a drifting ice station. Logistically and operationally support submarine and camp operations from a drifting ice station that is re-supplied via contracted commercial rotary and fixed-wing aviation services, via USTRANSCOM, from temporary infrastructure and services on the North Slope of Alaska. - Support Arctic deployments, including inter-Fleet transfers, as required by the SUBFOR Commanders. - Investigate, research, develop, and deploy new systems for Arctic submarine support. - Support testing and tactical development required to improve submarine Arctic operability and warfighting. - Conduct Arctic operations to support ice camp equipment evaluation, systems development and extreme cold weather training, and to also perform drifting sea ice analysis required to improve drifting sea ice camp Arctic operations. ***FY 2021 Base Plans:*** - Conduct Arctic work-up training. - Support Arctic deployments, including inter-Fleet transfers, as required by the SUBFOR Commanders. - Investigate, research, develop, and deploy new systems for Arctic submarine support. - Conduct Arctic operations to support ice camp equipment evaluation, systems development, and extreme cold weather training, and to also perform drifting sea ice analysis required to improve drifting sea ice camp Arctic operations. - Support testing and tactical development required to improve submarine Arctic operability and warfighting. - Initiate planning, logistics support, procurement, and preparation for ICEX mission 2022 and Ice Camp 2022. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** - FY 2020 ($6.635M) to FY 2021 ($5.755M) decrease ($-0.880M) is driven by FY 2021 being an ICEX planning year (no major ICEX/Ice Camp events scheduled in FY 2021).					
Accomplishments/Planned Programs Subtotals	5.022	6.635	5.755	0.000	5.755

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 1739 / *Submarine Arctic W/F Development*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

- This project is a non-Acquisition Category (ACAT) program.
- Use Naval Undersea Warfare Center (NUWC) to provide technical assistance awarded through NAVSEA Reimbursable Work Order.
- Use sole source and competitively awarded contracts through the U.S. Army Corps of Engineers (USACE) Alaska regional office for ICEX Ice Camp logistics, engineering, and operations support.
- Use sole source and competitively awarded contracts through the Fleet Logistics Center (FLC) regional contracting office and Defense Logistics Agency (DLA) for equipment procurement and technical services.
- Use sole source and competitively awarded contracts through the U.S. Transportation Command for ICEX aviation support.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 1739 / *Submarine Arctic W/F Development*

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Conduct ICEX and Arctic Transit Mission, ICEX Workup and Training, Ice Camps	WR	COMSUBLANT : VA	8.370	2.979	Oct 2018	4.268	Oct 2019	3.500	Nov 2020	-		3.500	Continuing	Continuing	Continuing
Conduct ICEX and Arctic Transit Mission, ICEX Workup and Training, Ice Camps	WR	COMSUBPAC : CA	36.101	0.000		0.000		0.000		-		0.000	0.000	36.101	-
Conduct ICEX and Arctic Transit Mission, ICEX Workup and Training, Ice Camps	WR	NUWC/Keyport : WA	0.468	0.375	Dec 2018	0.149	Oct 2019	0.303	Nov 2020	-		0.303	Continuing	Continuing	Continuing
Conduct ICEX and Arctic Transit Mission, ICEX Workup and Training, Ice Camps	WR	NUWC/Newport : RI	1.795	0.000	Jan 2019	0.121	Oct 2019	0.000		-		0.000	Continuing	Continuing	Continuing
Conduct ICEX and Arctic Transit Mission, ICEX Workup and Training, Ice Camps	MIPR	USACE : AK	2.715	1.486	Dec 2018	0.150	Nov 2019	1.400	Dec 2020	-		1.400	Continuing	Continuing	Continuing
Conduct ICEX and Arctic Transit Mission, ICEX Workup and Training, Ice Camps	MIPR	USTRANSCOM : IL	1.505	0.065	Dec 2018	1.600	Dec 2019	0.100	Dec 2020	-		0.100	Continuing	Continuing	Continuing
Conduct ICEX and Arctic Transit Mission, ICEX Workup and Training, Ice Camps	C/CPFF	UT/ARL : TX	1.434	0.010	Feb 2019	0.000		0.100	Jan 2021	-		0.100	Continuing	Continuing	Continuing
Conduct ICEX and Arctic Transit Mission, ICEX Workup and Training, Ice Camps	C/CPFF	UW/APL : WA	15.827	0.000		0.000		0.000		-		0.000	0.000	15.827	Continuing
Conduct ICEX and Arctic Transit Mission, ICEX	C/CPFF	VAR* : VAR	0.334	0.005	Jan 2019	0.243	Dec 2019	0.246	Dec 2020	-		0.246	Continuing	Continuing	Continuing

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Navy			Date: February 2020
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603562N / *Submarine Tactical Warfare Sys*	Project (Number/Name) 1739 / *Submarine Arctic W/F Development*	

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Workup and Training, Ice Camps															
		Subtotal	68.549	4.920		6.531		5.649		-		5.649	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 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Program Management Support - Acquisition, Business & Finance	C/CPAF	EG&G : VA	0.311	0.000		0.000		0.000		-		0.000	0.000	0.311	-
Program Management Support - Acquisition, Business & Finance	C/CPAF	BAE SYSTEMS : MD	1.088	0.000		0.000		0.000		-		0.000	0.000	1.088	-
Program Management Support - Acquisition, Business & Finance	C/CPIF	TMB : DC	0.220	0.102	Dec 2018	0.000		0.000		-		0.000	0.000	0.322	Continuing
Program Management Support - Acquisition, Business & Finance	C/CPFF	TBD (TMB Follow On) : TBD	0.000	0.000		0.104	Jan 2020	0.106	Dec 2020	-		0.106	Continuing	Continuing	Continuing
Program Office Travel	Allot	NAVSEA PEO IWS 5 : DC	0.040	0.000		0.000		0.000		-		0.000	0.000	0.040	-
		Subtotal	1.659	0.102		0.104		0.106		-		0.106	Continuing	Continuing	N/A

	Prior Years	FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	70.208	5.022		6.635		5.755		-		5.755	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 1739 / *Submarine Arctic W/F Development*

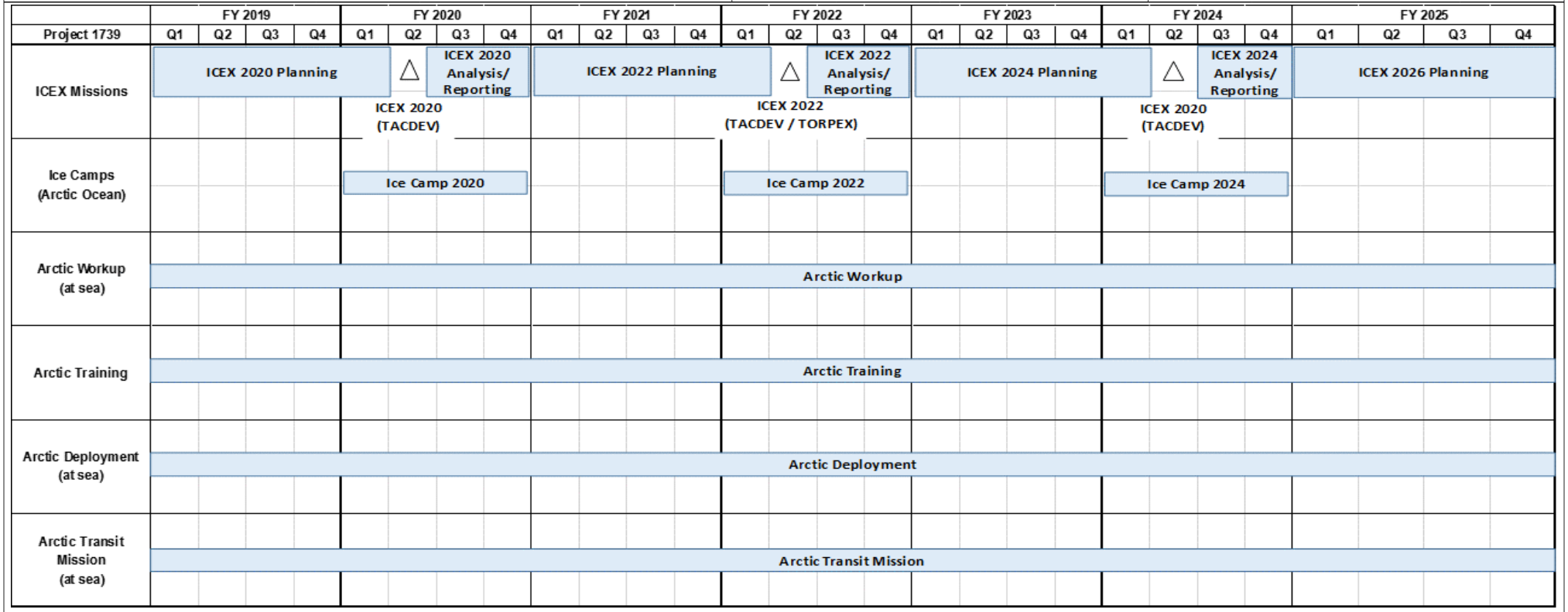

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 1739 / *Submarine Arctic W/F Development*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Proj 1739				
ICEX Mission 2020 (TACDEV) Planning/Logistics	1	2019	1	2020
ICEX Mission 2020 (TACDEV)	2	2020	2	2020
ICEX Mission 2020 (TACDEV) Post-ICEX Analysis/Reporting	3	2020	4	2020
ICEX Mission 2022 (TACDEV / TORPEX) Planning/Logistics	1	2021	1	2022
ICEX Mission 2022 (TACDEV / TORPEX)	2	2022	2	2022
ICEX Mission 2022 (TACDEV / TORPEX) Post-ICEX Analysis/Reporting	3	2022	4	2022
ICEX Mission 2024 (TACDEV) Planning/Logistics	1	2023	1	2024
ICEX Mission 2024 (TACDEV)	2	2024	2	2024
ICEX Mission 2024 (TACDEV) Post-ICEX Analysis/Reporting	3	2024	4	2024
ICEX Mission 2026 (TACDEV) Planning/Logistics	1	2025	4	2025
Ice Camp (Arctic Ocean) 2020	1	2020	4	2020
Ice Camp (Arctic Ocean) 2022	1	2022	4	2022
Ice Camp (Arctic Ocean) 2024	1	2024	4	2024
Arctic Workup (At Sea)	1	2019	4	2025
Arctic Training	1	2019	4	2025
Arctic Submarine Deployment as required by the Submarine Type Commander	1	2019	4	2025
Arctic Transit Mission (At Sea)	1	2019	4	2025

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603562N / *Submarine Tactical Warfare Sys*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	2.894	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.894
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

A continuing need exists to improve Electronic Warfare (EW) capabilities in view of the advancements in potential imaging counter detection and the increasingly dense electromagnetic environment caused by the proliferation of complex radar, communications, and navigation equipment of potential adversaries. Improvements are necessary for submarine EW to be operationally effective in the following mission areas: Joint Littoral Warfare, Joint Surveillance, Space and Electronic Warfare, Intelligence Collection, Maritime Protection, and Joint Strike. The evaluation of state-of-the-art technology to implement periscope/mast improvements via EW electromagnetic results in improved capability. Engineering Development Models (EDMs) are developed, evaluated, and validated in the lab and through at-sea testing.

This project supports development of capability improvements to submarine electronic surveillance measures that are used to detect, classify, localize, and record RADAR and Communications signals. The funding line also supports the specific development of high-speed digital networks and electronic attack demonstrations.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020
Congressional Add: Advanced Submarine Electronic Warfare Systems	2.894	0.000
FY 2019 Accomplishments: - Developed Field Programmable Gate Array (FPGA) based Peripheral Component Interconnect Express (PCIe) Switch brassboard and PCIe Switch software. - The Ship Countermeasure Warfare Integrated Demonstration (SCWID) effort is being undertaken to demonstrate the effectiveness of the current Georgia Technology Research Institute (GTRI) SCWID Electronic Attack (EA) techniques when interfaced to a platform-specific antenna assembly, while operating in a maritime environment. Develop a prototype to effectively use SCWID EA techniques with submarine representative antennas.		
FY 2020 Plans: - Complete and test two engineering development modules of the FPGA based PCIe Switch. - Complete and test a prototype to utilize SCWID EA techniques with submarine representative antennas in a simulated environment.		
Congressional Adds Subtotals	2.894	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 9999 / *Congressional Adds*

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
• RDT&E/0603562N/0770: *Adv Sub Supp Equip Prog*	4.264	4.557	4.773	-	4.773	4.810	4.890	4.980	5.077	Continuing	Continuing
• RDTE/0604503N/0775: *Submarine Supt Equip Prog*	24.796	21.235	30.115	-	30.115	31.999	33.379	32.808	33.467	Continuing	Continuing

Remarks

D. Acquisition Strategy

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

Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 9999 / *Congressional Adds*

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Advanced Submarine EW Systems	C/FFP	GTRI : Atlanta, GA	0.000	0.880	May 2019	0.000		0.000		-		0.000	0.000	0.880	-
Advanced Submarine EW Systems	WR	NUWC : Newport, RI	0.000	1.014	Dec 2018	0.000		0.000		-		0.000	0.000	1.014	-
Advanced Submarine EW Systems	C/FFP	Accipter : Wexford, PA	0.000	1.000	Jun 2019	0.000		0.000		-		0.000	0.000	1.000	-
		Subtotal	0.000	2.894		0.000		0.000		-		0.000	0.000	2.894	N/A

	Prior Years	FY 2019 Cost	FY 2019 Award Date	FY 2020 Cost	FY 2020 Award Date	FY 2021 Base Cost	FY 2021 Base Award Date	FY 2021 OCO Cost	FY 2021 OCO Award Date	FY 2021 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	0.000	2.894		0.000		0.000		-		0.000	0.000	2.894	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 9999 / *Congressional Adds*

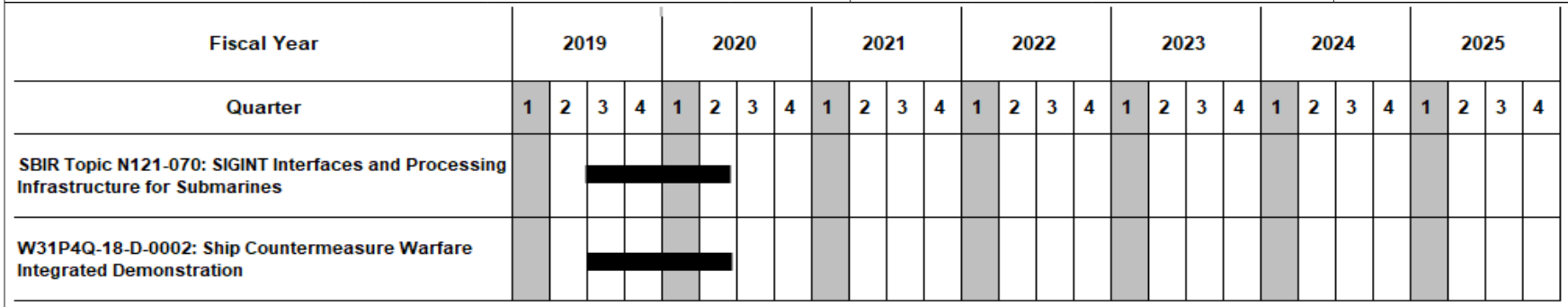

Exhibit R-4A, RDT&E Schedule Details: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 9999 / *Congressional Adds*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Proj 9999				
SBIR Topic N121-070: SIGINT Interfaces and Processing Infrastructure for Submarines: SBIR Topic N121-070: SIGINT Interfaces and Processing Infrastructure for Submarines	3	2019	2	2020
W31P4Q-18-D-0002: Ship Countermeasure Warfare Integrated Demonstration: W31P4Q-18-D-0002: Ship Countermeasure Warfare Integrated Demonstration	3	2019	2	2020