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 0603562N *I Submarine Tactical Warfare Sys*							
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	82.024	13.597	12.374	11.192	-	11.192	11.481	13.311	11.952	12.189	Continuing	Continuing
0770: *Adv Sub Supp Equip Prog*	21.293	4.120	4.307	4.557	-	4.557	4.718	4.822	4.908	5.004	Continuing	Continuing
1739: *Submarine Arctic W/F Development*	60.731	9.477	5.067	6.635	-	6.635	6.763	8.489	7.044	7.185	Continuing	Continuing
9999: *Congressional Adds*	0.000	0.000	3.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	3.000

A. Mission Description and Budget Item Justification

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

PROJECT 1739 - The Submarine Arctic Warfare Development Project 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 advisors to the Commanding Officer.

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 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. Efforts include assessment of combat system effectiveness, development of Arctic specific improvements for existing sonar and weapons, development of class-specific Arctic operational guidelines, and testing of ice-capable submarine support structures.

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 0603562N *I Submarine Tactical Warfare Sys*

Major ICEXs, occurring every four (4) years (FY 2018, FY 2022, etc.) include a Fleet requirement to conduct exercise torpedo (EXTORP) firings in the Arctic. A Torpedo Exercise (TORPEX) requires 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 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	13.834	9.374	11.314	-	11.314
Current President's Budget	13.597	12.374	11.192	-	11.192
Total Adjustments	-0.237	3.000	-0.122	-	-0.122
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	3.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.238	0.000			
• Program Adjustments	0.000	0.000	-0.007	-	-0.007
• Rate/Misc Adjustments	0.001	0.000	-0.115	-	-0.115

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2018	FY 2019
Project: 9999: *Congressional Adds*		
Congressional Add: *Advanced Submarine Electronic Warfare Systems*	0.000	3.000
Congressional Add Subtotals for Project: 9999	0.000	3.000
Congressional Add Totals for all Projects	0.000	3.000

Change Summary Explanation

FUNDING CHANGES AT THE OVERALL PE LEVEL:
- FY 2018 decrease of $-0.237M included: $-0.238M for Small Business Innovative Research (SBIR) transfer, and $+0.001M for various rate adjustment.
- FY 2019 increase of $+3.000M reflects Congressionally directed add for Advanced Submarine Electronic Warfare Systems.
- FY 2020 decrease of $-0.122M reflects minor program and various rate adjustments.

PROJECT 1739 FY 2019 to FY 2020 Increase/Decrease Statement: FY 2019 ($5.067M) to FY 2020 ($6.635M) increase ($+1.568M) is driven by the requirement to execute/conduct the major TACDEV ICEX events scheduled in FY 2020. These events are schedule on a biennial basis and require additional efforts and resources in aviation, personnel, logistics, and operations. FY 2019 is a planning and development year for the events to be conducted in FY 2020. There are no major TACDEV ICEX events planned in FY 2019. Additional efforts in FY 2020 also include the conduct of Arctic work-up training, Arctic transit mission, personnel deployments to drifting ice floes in the Arctic, and ICEX 2020 post mission analysis.

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 0603562N / *Submarine Tactical Warfare Sys*	Project (Number/Name) 0770 / *Adv Sub Supp Equip Prog*	

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
0770: *Adv Sub Supp Equip Prog*	21.293	4.120	4.307	4.557	-	4.557	4.718	4.822	4.908	5.004	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

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

The FY20 Advanced Imaging Project Development projects include Anti Reflective Coating Spherical Domes, Volumetric Atmospheric Modeling, Low Power Fiber Delivered Laser Range Finder, Reduced Cost Fabrication of Optical Sapphire Hyper-hemispheres, Vulnerability Improvement, Submarine Meteorological Sensors, System For Non-Acoustic Control of Signatures (SNACS), Imaging Buoy, Near Ocean Imaging through Atmospheric Turbulence and a Project Arrangement (PA) with Australia covering Electromagnetic Spectrum Sensor System Simulation & Development for model-based mission planning.

The FY20 Advanced EW Project Development projects include the development of: Extremely Wideband Digital Receiver (NATO Nunn Project with NAVAIR and Australia), Disposable Decoy Buoys, ISR and Tethered Buoys and Antennas, Radio Frequency (RF) over Fiber (RFoF), Micro-Adaptive Trainer, Mast Antenna Coupler, Ruggedized High speed Optical Fiber Network Connector Interfaces, Data Transmission Using Visible Light Communications (VLC), Digital Early Warning Receiver, Tunable Optic Filters for Radio Frequencies Photonic Signal Distribution Systems, Solid State RADAR Emitter Identification, RADAR Vulnerability Assessment Tool (RVAT) improvements, Virginia (VA) class submarine Direction Finding (DF) improvements, Low Probability of Intercept (LPI) RADAR improvements, solid state RADAR emitter identification improvements, and to provide Subject Matter Expertise (SME) support to the Electronic Warfare Working Group (EWWG). The EW ASSEP line will also develop items, software, and techniques to be assessed during Advanced Processor Build (APB) step testing events.

FY19 to FY20 cost growth is due to the start of three high priority EW developmental efforts: RADAR Vulnerability Assessment Tool (RVAT) improvements, Virginia (VA) class submarine Direction Finding (DF) improvements, and Low Probability of Intercept (LPI) RADAR improvements.

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

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
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 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: Advanced Imaging Project Development	2.325	2.561	2.279	0.000	2.279
Articles:	-	-	-	-	-
FY 2019 Plans: Continue Meteorological Development Complete Low Power Fiber Delivered Laser Range Finder Lab Test and Continue Development Complete Reduced Cost Fabrication of Optical Sapphire Hyper-hemispheres Lab Test and Continue Development Complete Anti-reflective Coating Spherical Domes Lab Test and Continue Development Complete Volumetric Atmospheric Modeling Lab Test and Continue Development Continue Near Ocean Imaging through Atmospheric Turbulence Development Complete Vulnerability Improvement Test and Continue Development Continue System for Non-Acoustic Control of Signatures Development Complete PA Electromagnetic Spectrum Sensor System Simulation Lab Test and Continue Development					
FY 2020 Base 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 Complete PA Electromagnetic Spectrum Sensor System Simulation & Development for Model - Based Mission Planning Test and Transition to Imaging					
FY 2020 OCO Plans: N/A					
FY 2019 to FY 2020 Increase/Decrease Statement:					

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 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 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Decrease of $282K in FY20 from FY19 is result of completion of Low Power Fiber Delivered Laser Range Finder and Reduced Cost Fabrication of Optical Sapphire Hyper-hemispheres projects.					
Title: Advanced Electronic Warfare Support (EW) Project Development	1.795	1.746	2.278	0.000	2.278
Articles:	-	-	-	-	-
FY 2019 Plans: Complete Solid State RADAR Emitter Identification test and Continue Development Complete EW Digital Direction Finding Lab Test and Continue Development Continue Extremely Wideband Digital Receiver Lab Test and Continue Development Complete Development Wideband Digitizers (Disarmer) and transition to EW Continue Development Tunable Optical Filters for Radio Frequency (RF)Photonic Signal Distributions System Continue Development Data Transmission using Visible Light Communications (VLC) for Undersea Platforms Continue Development Ruggedized High Speed Optical Fiber Network Connector Interfaces for Next Generation Submarine Electronic Warfare (EW) Systems Complete Disposable Buoy Modular Expendable Decoy enhancements Lab Test and Continue Development Complete Disposable Buoy Modular Expendable Intelligence Surveillance and reconnaissance (ISR) Lab Test and Continue Development Complete Tethered Buoy Modular Tethered Antenna Lab Test and Continue Development Complete Tethered Buoy Radio Frequency over Fiber (RFoF) Lab Test and Continue Development Complete Precision DF Lab Test and Transition to EW Complete Multifunction Apertures (SUBSTAR FNC) Lab Test and Transition to EW Start Development of Micro Adaptive Training FY19 FNC Start Development of Mast Antenna Coupler					
FY 2020 Base Plans: Complete Lab Test and Transition Solid State RADAR Emitter Identification to EW Complete EW Digital Direction Finding and transition to EW Complete Extremely Wideband Digital Receiver Lab Test and Transition to EW Complete Tunable Optical Filters for Radio Frequency (RF)Photonic Signal Distributions System Lab Test #2 Complete Data Transmission using Visible Light Comms (VLC) for Undersea Platforms Lab Test Complete Ruggedized High Speed Optical Fiber Network Connector Interfaces for NEXGEN EW Lab Test Complete TI-22 Disposable Buoys Modular Expendable Decoy Buoy Enhancement and Transition to EW					

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 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 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
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 Start RADAR Vulnerability Assessment Tool Development (RVAT) and complete Step 2 & 3 Test Start Virginia Class Submarine Direction Finding Improvement (VA DF) Development and complete Step 2 & 3 Test Start LPI RADAR improvement and complete Step 2 & 3 Test ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Increase cost of $532K from FY19 to FY20 is the result growth due to the start of the following three high priority EW developmental efforts: RADAR Vulnerability Assessment Tool (RVAT) improvements, Virginia (VA) class submarine Direction Finding (DF) improvements, and Low Probability of Intercept (LPI) RADAR improvements.					
Accomplishments/Planned Programs Subtotals	4.120	4.307	4.557	0.000	4.557

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

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

E. Performance Metrics

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

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy		Date: March 2019
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 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
Systems Engineering	WR	NUWC : RI	20.374	4.092	Nov 2017	4.279	Nov 2018	3.306	Nov 2019	-		3.306	Continuing	Continuing	Continuing
Primary Software and Hardware Development	C/FP	JHU/APL : MD	0.000	0.000		0.000	Nov 2018	0.513	Nov 2019	-		0.513	0.000	0.513	-
Primary Software and Hardware Development	MIPR	MIT/LL : MA	0.590	0.000		0.000	Nov 2018	0.710	Nov 2019	-		0.710	0.000	1.300	-
		Subtotal	20.964	4.092		4.279		4.529		-		4.529	Continuing	Continuing	N/A

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Travel	WR	NAVSEA : WNY	0.329	0.028	Nov 2017	0.028	Nov 2018	0.028	Nov 2019	-		0.028	Continuing	Continuing	Continuing
		Subtotal	0.329	0.028		0.028		0.028		-		0.028	Continuing	Continuing	N/A

	Prior Years	FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	21.293	4.120		4.307		4.557		-		4.557	Continuing	Continuing	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 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

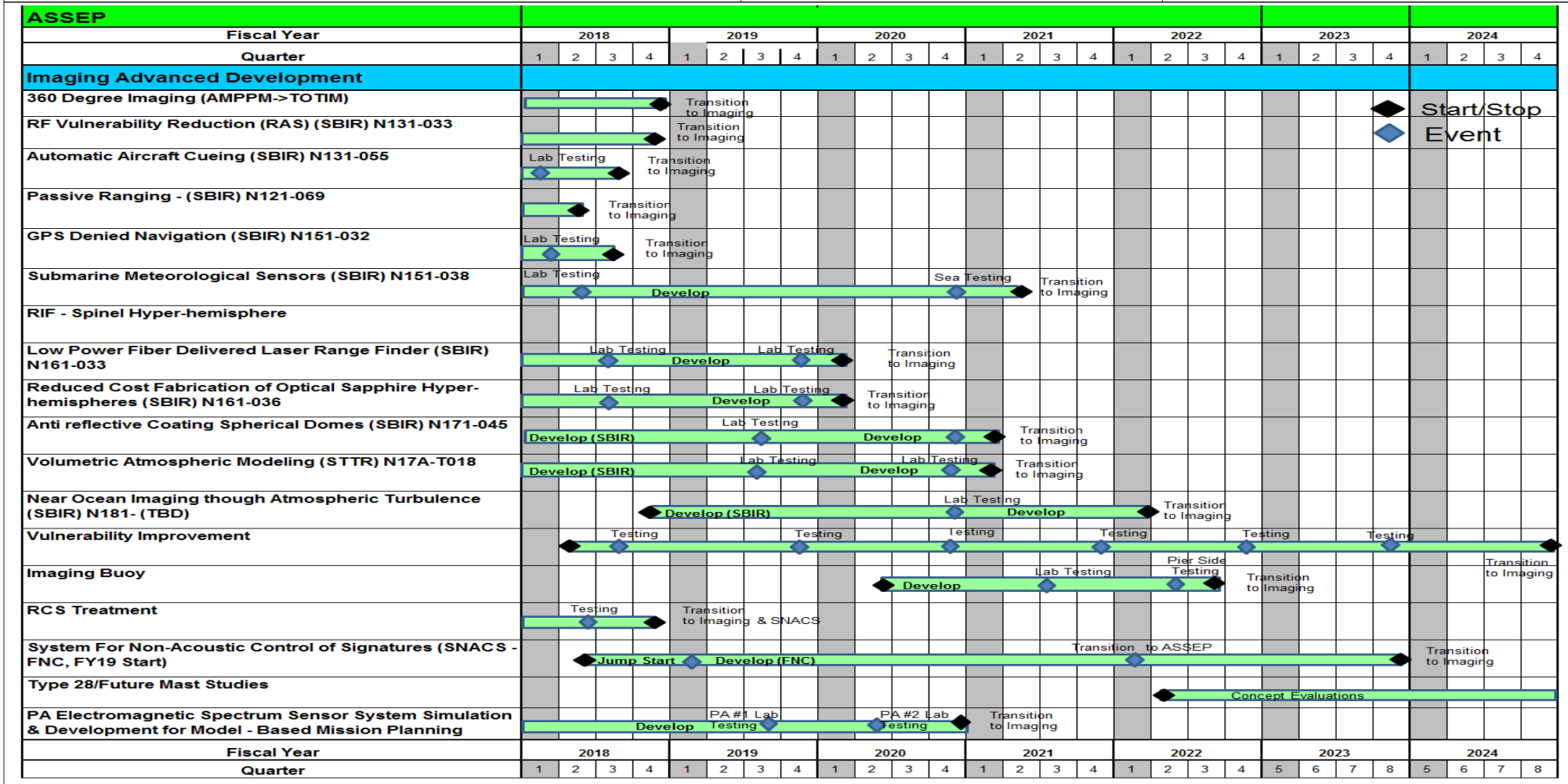

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

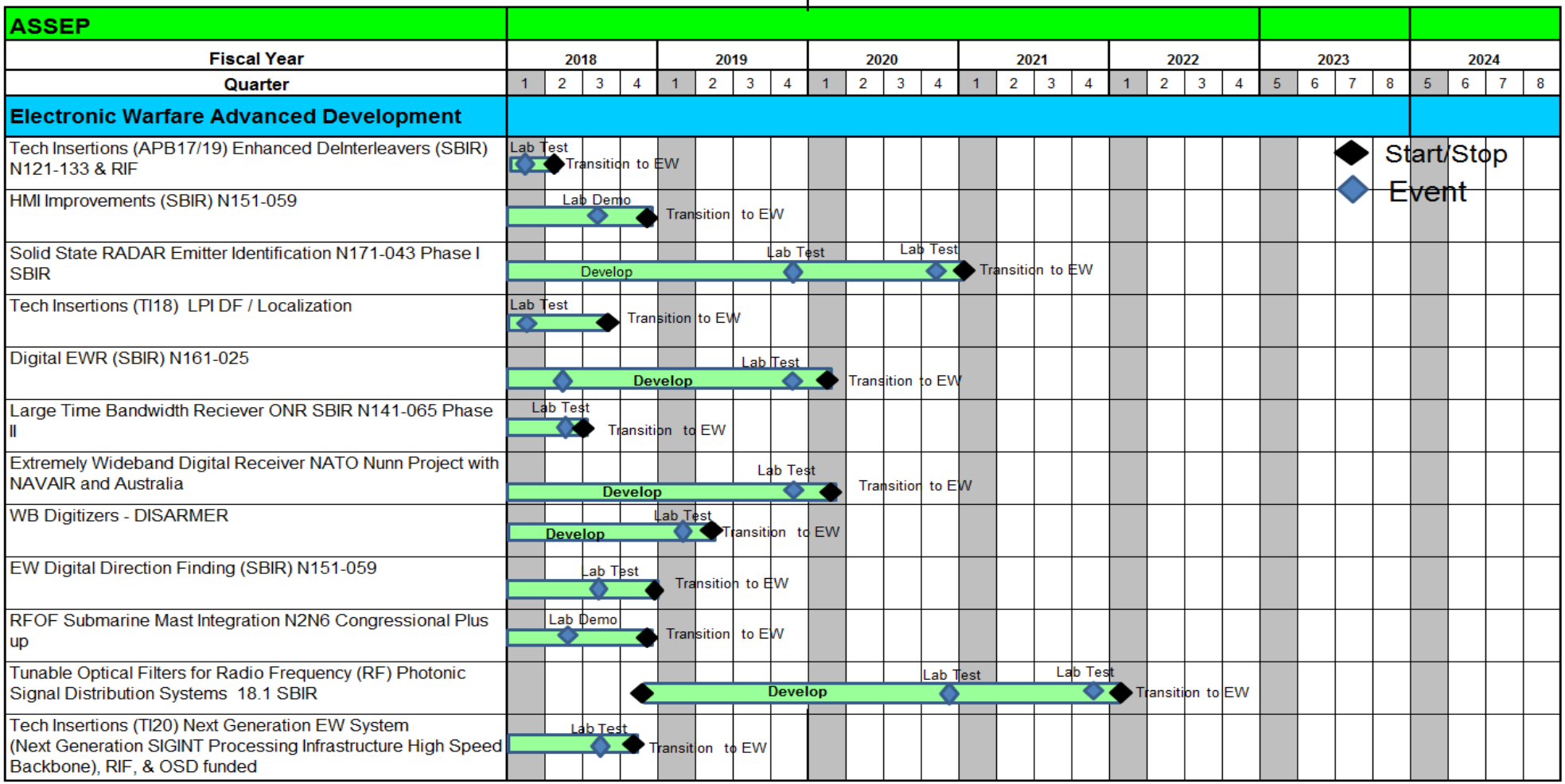

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

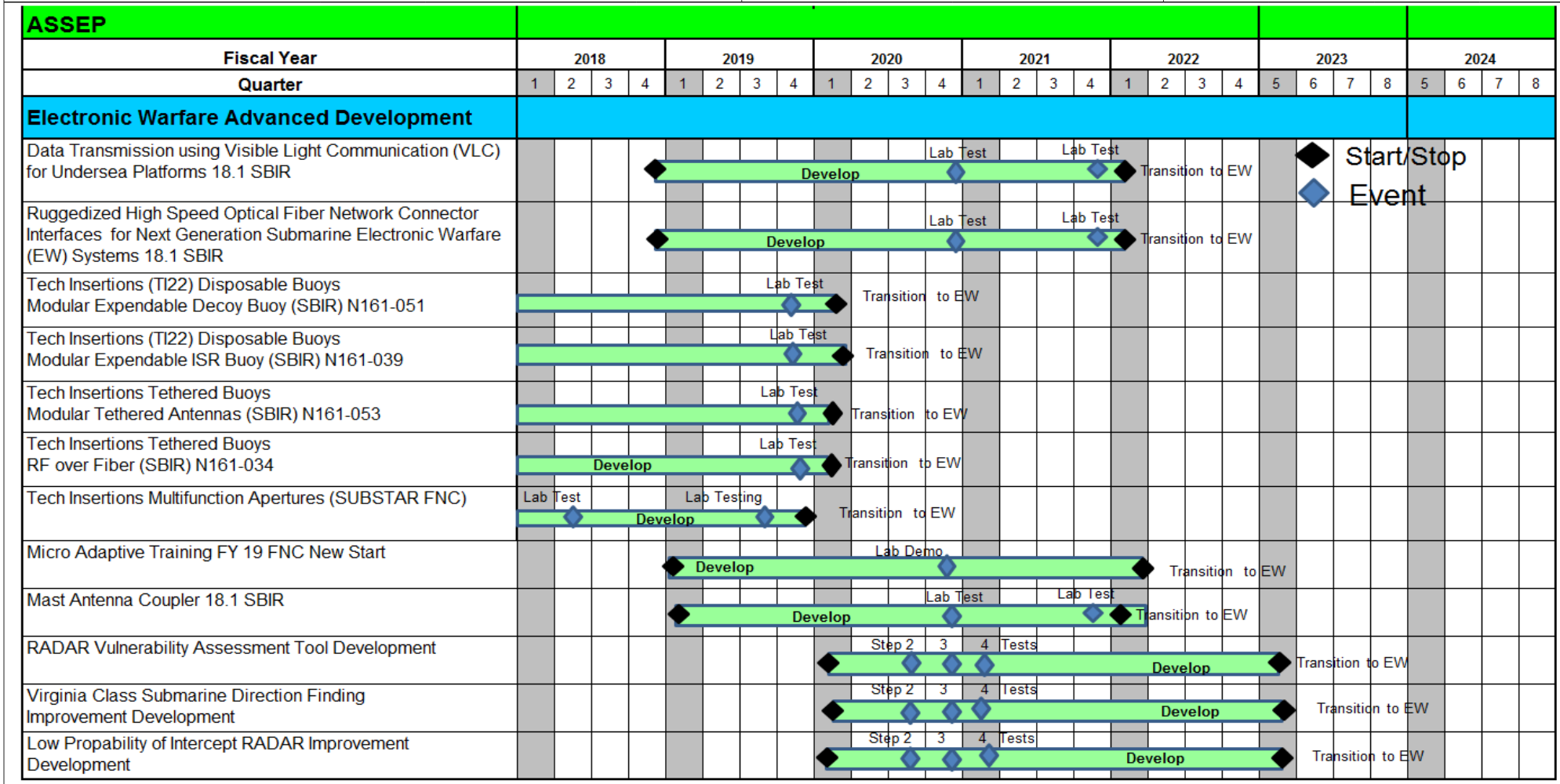

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Imaging Advanced Development				
360 Degree Imaging (TOTIM) Transition to Imaging	4	2018	4	2018
RF Vulnerability Reduction (RAS) Transition to Imaging	4	2018	4	2018
Automatic Aircraft Cueing Lab Test	1	2018	1	2018
Automatic Aircraft Cueing Transition to Imaging	3	2018	3	2018
Passive Ranging Transition to Imaging	2	2018	2	2018
GPS Denied Navigation Lab Test #2	1	2018	1	2018
GPS Denied Navigation Transition to Imaging	3	2018	3	2018
Submarine Meteorological Sensors Lab Test	2	2018	2	2018
Submarine Meteorological Sensors Sea Test #2	4	2020	4	2020
Submarine Meteorological Sensors Transition to Imaging	2	2021	2	2021
Low Power Fiber Delivered Laser Range Finder Lab Test	3	2018	3	2018
Low Power Fiber Delivered Laser Range Finder Lab Test #2	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 Lab Test	3	2018	3	2018
Reduced Cost Fabrication of Optical Sapphire Hyper-hemispheres Lab Test #2	4	2019	4	2019
Reduced Cost Fabrication of Optical Sapphire Hyper-hemispheres Transition to Imaging	1	2020	1	2020
Anti-reflective Coating Spherical Domes Lab Test	3	2019	3	2019
Anti-reflective Coating Spherical Domes Lab Test #2	4	2020	4	2020
Anti -eflective Coating Spherical Domes Transition to Imaging	1	2021	1	2021
Volumetric Atmospheric Modeling Lab Test	3	2019	3	2019

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 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Volumetric Atmospheric Modeling Lab Test #2	4	2020	4	2020
Volumetric Atmospheric Modeling Transition to Imaging	1	2021	1	2021
Near Ocean Imaging though Atmospheric Turbulence Development	4	2018	4	2018
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
Vulnerability Improvement Development	2	2018	3	2024
Vulnerability Improvement Lab Test	3	2018	3	2018
Vulnerability Improvement Lab Test #2	4	2019	4	2019
Vulnerability Improvement Lab Test #3	4	2020	4	2020
Vulnerability Improvement Lab Test #4	4	2021	4	2021
Vulnerability Improvement Lab Test #5	4	2022	4	2022
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
RCS Treatment Testing	2	2018	2	2018
RCS Treatment Transition to Imaging	4	2018	4	2018
System For Non-Acoustic Control of Signatures (SNACS - FNC, FY18 Jump Start)	2	2018	4	2023
SNACS FY19 FNC Start	1	2019	1	2019
SNACS transition to Imaging	4	2023	4	2023
Type 28/Future Mast Studies	2	2022	4	2024
PA Electromagnetic Spectrum Sensor System Simulation & Dev for Model - Based Mission Planning	1	2018	4	2020
PA Electromagnetic Spectrum Sensor System Simulation & Dev for Model - Based Mission Planning Test	3	2019	3	2019

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 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
PA Electromagnetic Spectrum Sensor System Simulation & Dev for Model - Based Mission Planning Test #2	2	2020	2	2020
PA Electromagnetic Spectrum Sensor System Simulation & Dev for Model - Based Mission Planning Transition to Imaging	4	2020	4	2020
Electronic Warfare Advanced Development: Tech Insertions (APB17/19) Enhanced DeInterleavers Lab Test	1	2018	1	2018
Electronic Warfare Advanced Development: Tech Insertions (APB17/19) Enhanced DeInterleavers - Transition to EW	2	2018	2	2018
Electronic Warfare Advanced Development: HMI Lab Demo #2	3	2018	3	2018
Electronic Warfare Advanced Development: HMI Transition to EW	4	2018	4	2018
Electronic Warfare Advanced Development: Solid State RADAR Emitter Identification Lab Test	4	2019	4	2019
Electronic Warfare Advanced Development: Solid State RADAR Emitter Identification Lab Test #2	4	2020	4	2020
Electronic Warfare Advanced Development: Solid State RADAR Emitter Identification - Transition to EW	1	2021	1	2021
Electronic Warfare Advanced Development: TI LPI DF/Localization Lab Test	1	2018	1	2018
Electronic Warfare Advanced Development: TI LPI DF/Localization Transition to EW	3	2018	3	2018
Electronic Warfare Advanced Development: Digital EWR Lab Test	2	2018	2	2018
Electronic Warfare Advanced Development: Digital EWR Lab Test #2	4	2019	4	2019
Electronic Warfare Advanced Development: Digital EWR Transition to EW	1	2020	1	2020
Electronic Warfare Advanced Development: Large Time Bandwidth Receiver Lab Test	3	2018	3	2018
Electronic Warfare Advanced Development: Large Time Bandwidth Receiver - Transition to EW	4	2018	4	2018
Electronic Warfare Advanced Development: Extremely Wideband Digital Receiver NATO Nunn Project with NAVAIR and Australia	2	2018	2	2018
Electronic Warfare Advanced Development: Extremely Wideband Digital Receiver NATO Nunn Project with NAVAIR and Australia Lab Test	4	2019	4	2019

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 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Electronic Warfare Advanced Development: Extremely Wideband Digital Receiver NATO Nunn Project with NAVAIR and Australia Transition to EW	1	2020	1	2020
Electronic Warfare Advanced Development: DISARMER Lab Test	1	2019	1	2019
Electronic Warfare Advanced Development: DISARMER Transition to EW	2	2019	2	2019
Electronic Warfare Advanced Development: EW Digital Direction Finding Lab Test	3	2018	3	2018
Electronic Warfare Advanced Development: EW Digital Direction Finding Transition to EW	4	2018	4	2018
Electronic Warfare Advanced Development: RFOF Submarine Mast Integration Lab Demo	2	2018	2	2018
Electronic Warfare Advanced Development: RFOF Submarine Mast Integration - Transition to EW	4	2018	4	2018
Electronic Warfare Advanced Development: Tunable Optical Filters for Radio Frequency (RF) Photonic Signal Distribution Systems	1	2019	1	2022
Electronic Warfare Advanced Development: Tunable Optical Filters for Radio Frequency (RF) Photonic Signal Distributions System Lab Test	4	2020	4	2020
Electronic Warfare Advanced Development: Tunable Optical Filters for Radio Frequency (RF) Photonic Signal Distribution Systems Lab Test #2	4	2021	4	2021
Electronic Warfare Advanced Development: Tunable Optical Filters for Radio Frequency (RF) Photonic Signal Distribution Systems - Transition to EW	1	2022	1	2022
Electronic Warfare Advanced Development: Next Generation SIGINT Processing Infrastructure High Speed Backbone Lab Test	3	2018	3	2018
Electronic Warfare Advanced Development: Next Generation SIGINT Processing Infrastructure High Speed Backbone Transition to EW	4	2018	4	2018
Electronic Warfare Advanced Development: Data Transmission using Visible Light Comms(VLC) for Undersea Platforms	4	2018	1	2022
Electronic Warfare Advanced Development: Data Transmission using Visible Light Comms(VLC) for Undersea Platforms Lab Test	4	2020	4	2020

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 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Electronic Warfare Advanced Development: Data Transmission using Visible Light Comms(VLC) for Undersea Platforms Lab Test #2	4	2021	4	2021
Electronic Warfare Advanced Development: Data Transmission using Visible Light Comms(VLC) for Undersea Platforms Transition to EW	1	2022	1	2022
Electronic Warfare Advanced Development: Ruggedized High Speed Optical Fiber Network Connector Interfaces for NEXGEN EW	4	2018	3	2022
Electronic Warfare Advanced Development: Ruggedized High Speed Optical Fiber Network Connector Interfaces for NEXGEN EW Lab Test	4	2020	4	2020
Electronic Warfare Advanced Development: Ruggedized High Speed Optical Fiber Network Connector Interfaces for NEXGEN EW Lab Test #2	4	2021	4	2021
Electronic Warfare Advanced Development: Ruggedized High Speed Optical Fiber Network Connector Interfaces for NEXGEN EW Transition to EW	1	2022	1	2022
Electronic Warfare Advanced Development: TI-22 Disposable Buoys Modular Expendable ISR Buoy Lab Test	4	2019	4	2019
Electronic Warfare Advanced Development: TI-22 Disposable Buoys Modular Expendable ISR Buoy Transition to EW	1	2020	1	2020
Electronic Warfare Advanced Development: TI-22 Disposable Buoys Sub Launched Decoy Speed to Fleet Lab Test	4	2019	4	2019
Electronic Warfare Advanced Development: TI-22 Disposable Buoys Sub Launched Decoy Speed to Fleet Transition to EW	1	2020	1	2020
Electronic Warfare Advanced Development: TI Tethered Buoys Modular Tethered Antennas and RF Over Fiber Lab Tests	4	2019	4	2019
Electronic Warfare Advanced Development: TI Tethered Buoys Modular Tethered Antennas and RF Over Fiber Transition to EW	1	2020	1	2020
Electronic Warfare Advanced Development: TI Precision DF Lab Test	2	2019	2	2019
Electronic Warfare Advanced Development: TI Precision DF Transition to EW	4	2019	4	2019
Electronic Warfare Advanced Development: TI Multifunctional Apertures Lab Test	2	2018	2	2018
Electronic Warfare Advanced Development: TI Multifunctional Apertures Lab Test #2	2	2019	2	2019

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 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Electronic Warfare Advanced Development: TI Multifunctional Apertures Transition to EW	4	2019	4	2019
Electronic Warfare Advanced Development: Micro Adaptive Training FY 19 FNC New Start	1	2019	1	2021
Electronic Warfare Advanced Development: Micro Adaptive Training FY19 Lab Demo	4	2020	4	2020
Electronic Warfare Advanced Development: Micro Adaptive Training FY 19 FNC Transition to EW	1	2022	1	2022
Electronic Warfare Advanced Development: Mast Antenna Coupler Development	1	2019	1	2022
Electronic Warfare Advanced Development: Mast Antenna Coupler Lab Test	4	2020	4	2020
Electronic Warfare Advanced Development: Mast Antenna Coupler Lab Test #2	4	2021	4	2021
Electronic Warfare Advanced Development: Mast Antenna Coupler Transition to EW	1	2022	1	2022
Electronic Warfare Advanced Development: RADAR Vulnerability Assessment Tool Development	1	2020	1	2022
Electronic Warfare Advanced Development: RADAR Vulnerability Assessment Tool Step 2 Test	3	2020	3	2020
Electronic Warfare Advanced Development: RADAR Vulnerability Assessment Tool Step 3 Test	4	2020	4	2020
Electronic Warfare Advanced Development: RADAR Vulnerability Assessment Tool Step 4 Test	1	2021	1	2021
Electronic Warfare Advanced Development: RADAR Vulnerability Assessment Tool Development Transition to EW	1	2023	1	2023
Electronic Warfare Advanced Development: Virginia Class Submarine Direction Finding Improvement Development	1	2020	1	2023
Electronic Warfare Advanced Development: Virginia Class Submarine Direction Finding Improvement Step 2 Test	3	2020	3	2020
Electronic Warfare Advanced Development: Virginia Class Submarine Direction Finding Improvement Step 3 Test	4	2020	4	2020

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 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 0770 / *Adv Sub Supp Equip Prog*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Electronic Warfare Advanced Development: Virginia Class Submarine Direction Finding Improvement Step 4 Test	1	2021	1	2021
Electronic Warfare Advanced Development: Virginia Class Submarine Direction Finding Improvement Transition to EW	1	2023	1	2023
Electronic Warfare Advanced Development: Low Probability of Intercept RADAR Improvement Development	1	2020	1	2023
Electronic Warfare Advanced Development: Low Probability of Intercept RADAR Improvement Step 2 Test	3	2020	3	2020
Electronic Warfare Advanced Development: Low Probability of Intercept RADAR Improvement Step 3 Test	4	2020	4	2020
Electronic Warfare Advanced Development: Low Probability of Intercept RADAR Improvement Step 4	1	2021	1	2021
Electronic Warfare Advanced Development: Low Probability of Intercept RADAR Improvement Test Transition to EW	1	2023	1	2023

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 0603562N / *Submarine Tactical Warfare Sys*	Project (Number/Name) 1739 / *Submarine Arctic W/F 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
1739: *Submarine Arctic W/F Development*	60.731	9.477	5.067	6.635	-	6.635	6.763	8.489	7.044	7.185	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 advisors to the Commanding Officer.

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 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. Efforts include assessment of combat system effectiveness, development of Arctic specific improvements for existing sonar and weapons, development of class-specific Arctic operational guidelines, and testing of ice-capable submarine support structures.

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

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: Conduct ICEX and Arctic Transit Mission, ICEX Workup and Training, Ice Camps	9.477	5.067	6.635	0.000	6.635
Articles:	-	-	-	-	-
FY 2019 Plans: - Conduct Arctic work-up training. - Support Arctic deployments, including inter-Fleet transfers, as required by the SUBFOR Commanders.					

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 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 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
- 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 as well as to 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 2020 and Ice Camp 2020. ***FY 2020 Base Plans:*** - Conduct Arctic work-up training, ICEX mission 2020, and Ice Camp 2020. - Conduct ICEX 2020 as a 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 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2019 to FY 2020 increase ($+1.568M) is driven by the requirement to execute/conduct the major TACDEV ICEX events scheduled in FY 2020. These events are schedule on a biennial basis and require additional efforts and resources in aviation, personnel, logistics, and operations. FY 2019 is a planning and development year for the events to be conducted in FY 2020. There are no major TACDEV ICEX events planned in FY 2019. Additional efforts in FY 2020 also include the conduct of Arctic work-up training, Arctic transit mission, personnel deployments to drifting ice floes in the Arctic, and ICEX 2020 post mission analysis.					
Accomplishments/Planned Programs Subtotals	9.477	5.067	6.635	0.000	6.635

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 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 1739 / *Submarine Arctic W/F Development*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

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

E. Performance Metrics

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

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 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 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Developmental Test & Evaluation	WR	COMSUBLANT : VA	5.257	3.113	Oct 2017	2.907	Oct 2018	3.528	Oct 2019	-		3.528	Continuing	Continuing	Continuing
Developmental Test & Evaluation	WR	COMSUBPAC : CA	36.101	0.000		0.000		0.000		-		0.000	0.000	36.101	-
Developmental Test & Evaluation	WR	NUWC/Keyport : WA	0.000	0.468	Sep 2018	0.375	Dec 2018	0.000		-		0.000	0.000	0.843	-
Developmental Test & Evaluation	WR	NUWC/Newport : RI	0.235	1.560	Oct 2017	0.007	Jan 2019	0.100	Oct 2019	-		0.100	Continuing	Continuing	Continuing
Developmental Test & Evaluation	MIPR	USACE : AK	0.852	1.863	Dec 2017	1.316	Dec 2018	0.960	Dec 2019	-		0.960	Continuing	Continuing	Continuing
Developmental Test & Evaluation	MIPR	USTRANSCOM : IL	0.110	1.395	Dec 2017	0.065	Dec 2018	1.700	Dec 2019	-		1.700	Continuing	Continuing	Continuing
Developmental Test & Evaluation	C/CPFF	UT/ARL : TX	1.434	0.000		0.050	Feb 2019	0.000		-		0.000	0.000	1.484	Continuing
Developmental Test & Evaluation	C/CPFF	UW/APL : WA	15.183	0.644	Dec 2017	0.000		0.000		-		0.000	0.000	15.827	Continuing
Developmental Test & Evaluation	C/CPFF	VAR : VAR	0.000	0.334	Dec 2017	0.245	Jan 2019	0.243	Dec 2019	-		0.243	Continuing	Continuing	Continuing
		Subtotal	59.172	9.377		4.965		6.531		-		6.531	Continuing	Continuing	N/A

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Program Management Support	C/CPAF	EG&G : VA	0.311	0.000		0.000		0.000		-		0.000	0.000	0.311	-
Program Management Support	C/CPAF	BAE SYSTEMS : MD	1.088	0.000		0.000		0.000		-		0.000	0.000	1.088	-
Program Management Support	C/CPIF	TMB : DC	0.120	0.100	Sep 2018	0.102	Dec 2018	0.104	Dec 2019	-		0.104	Continuing	Continuing	Continuing
Travel	Allot	NAVSEA PEO IWS 5 : DC	0.040	0.000		0.000		0.000		-		0.000	0.000	0.040	-

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 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 1739 / *Submarine Arctic W/F 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
		Subtotal	1.559	0.100		0.102		0.104		-		0.104	Continuing	Continuing	N/A

	Prior Years	FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	60.731	9.477		5.067		6.635		-		6.635	Continuing	Continuing	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 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 1739 / *Submarine Arctic W/F Development*

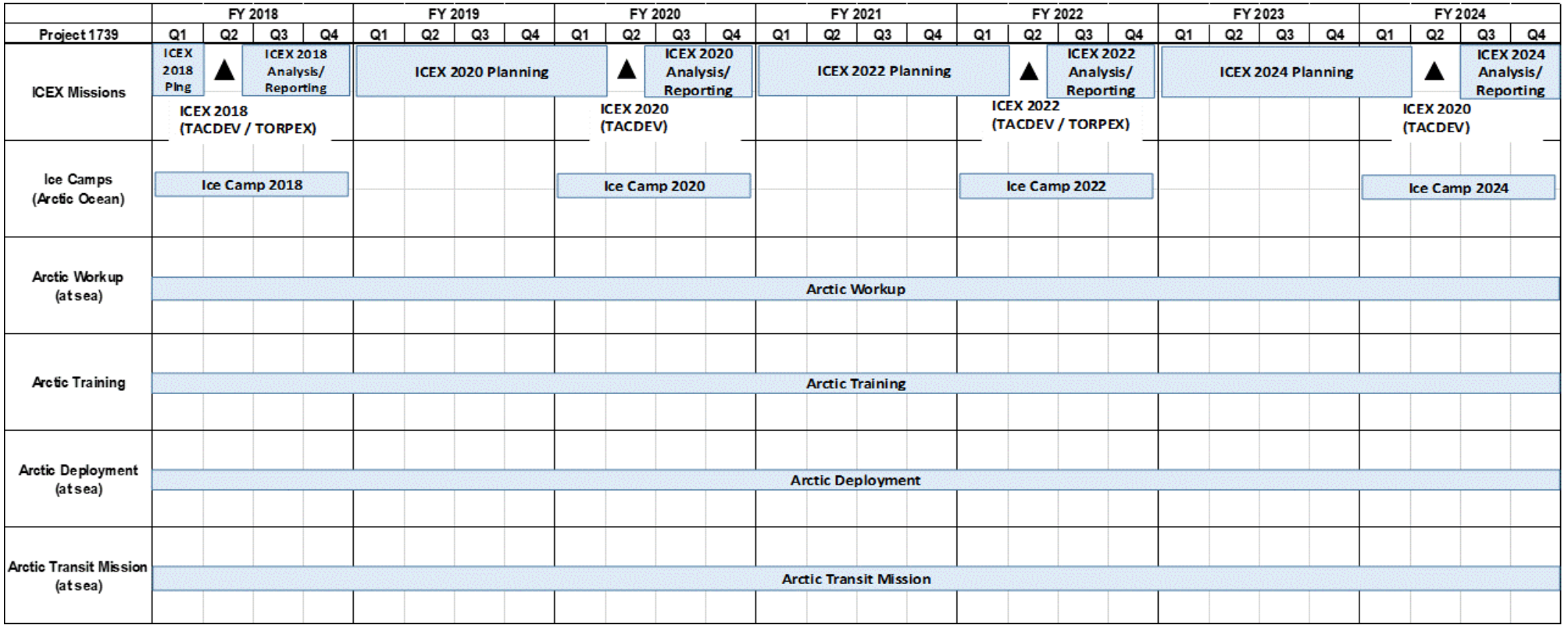

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 1739 / *Submarine Arctic W/F Development*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Proj 1739				
ICEX Missions: ICEX Mission 2018 (TACDEV / TORPEX) Planning/Logistics	1	2018	1	2018
ICEX Missions: ICEX Mission 2018 (TACDEV / TORPEX)	2	2018	2	2018
ICEX Missions: ICEX Mission 2018 (TACDEV / TORPEX) Post-ICEX Analysis/ Reporting	3	2018	4	2018
ICEX Missions: ICEX Mission 2020 (TACDEV) Planning/Logistics	1	2019	1	2020
ICEX Missions: ICEX Mission 2020 (TACDEV)	2	2020	2	2020
ICEX Missions: ICEX Mission 2020 (TACDEV) Post-ICEX Analysis/Reporting	3	2020	4	2020
ICEX Missions: ICEX Mission 2022 (TACDEV / TORPEX) Planning/Logistics	1	2021	1	2022
ICEX Missions: ICEX Mission 2022 (TACDEV / TORPEX)	2	2022	2	2022
ICEX Missions: ICEX Mission 2022 (TACDEV / TORPEX) Post-ICEX Analysis/ Reporting	3	2022	4	2022
ICEX Missions: ICEX Mission 2024 (TACDEV) Planning/Logistics	1	2023	1	2024
ICEX Missions: ICEX Mission 2024 (TACDEV)	2	2024	2	2024
ICEX Missions: ICEX Mission 2024 (TACDEV) Post-ICEX Analysis/Reporting	3	2024	4	2024
Ice Camps (Arctic Ocean): Ice Camp (Arctic Ocean) 2018	1	2018	4	2018
Ice Camps (Arctic Ocean): Ice Camp (Arctic Ocean) 2020	1	2020	4	2020
Ice Camps (Arctic Ocean): Ice Camp (Arctic Ocean) 2022	1	2022	4	2022
Ice Camps (Arctic Ocean): Ice Camp (Arctic Ocean) 2024	1	2024	4	2024
Arctic Workup (At Sea): Arctic Workup (At Sea)	1	2018	4	2024
Arctic Training: Arctic Training	1	2018	4	2024
Arctic Deployment (At Sea): Submarine Deployment as required by the Submarine Type Commander	1	2018	4	2024

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 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 1739 / *Submarine Arctic W/F Development*

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Arctic Transit Mission (At Sea): Arctic Transit Mission (At Sea)	1	2018	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 0603562N / *Submarine Tactical Warfare Sys*	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	0.000	3.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	3.000
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

A continuing need exists to improve Electronic Warfare support (EW) capabilities in view of the advancements in potential imaging counter detection and the increasingly dense electromagnetic environment caused by the proliferation of complex radar, communications, and navigation equipment of potential adversaries. Improvements are necessary for submarine EW 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 Demonstration Models (EDMs) are developed, evaluated, and validated in the lab and through at-sea testing.

The RDTE funding line 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 2018	FY 2019
Congressional Add: Advanced Submarine Electronic Warfare Systems	0.000	3.000
FY 2018 Accomplishments: N/A		
FY 2019 Plans: Continue development of the Field Programmable Gate Array (FPGA) based Peripheral Component Interconnect Express (PCIe) Switch brassboard and PCIe Switch software. Two engineering development modules will be completed and tested. 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. The goal of this effort is to demonstrate that the SCWID EA techniques can be used effectively with submarine representative antennas.		
Congressional Adds Subtotals	0.000	3.000

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 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 9999 / *Congressional Adds*

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
• RDT&E/0603562N/0770: *Adv Sub Supp Equip Prog*	4.120	4.307	4.557	-	4.557	4.718	4.822	4.908	5.004	Continuing	Continuing
• RDTE/0604503N/0775: *Submarine Supt Equip Prog*	9.082	28.408	27.273	-	27.273	19.902	30.232	33.266	32.853	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) dtd 27 Sep 2016 for the Electronic Warfare Systems. Project efforts develop submarine unique improvements to mast, periscope, and EW electromagnetic spectrum and electro-optic sensors based on emerging technologies that are available from DoD Exploratory Development Programs, industry Independent Research and Development, and other sources. Engineering Demonstration Models (EDMs) will be developed to provide a realistic method of evaluating the improvements, including deployment on submarines for testing.

E. Performance Metrics

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

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
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 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
Hardware and Software Development	C/FFP	GTRI : Atlanta, GA	0.000	0.000		0.880	Feb 2019	0.000		-		0.000	0.000	0.880	-
Hardware and Software Development	WR	NUWC : Newport, RI	0.000	0.000		1.120	Dec 2018	0.000		-		0.000	0.000	1.120	-
Hardware and S/W Development SCWID	C/FFP	Accipter : Wexford, PA	0.000	0.000		1.000	Feb 2019	0.000		-		0.000	0.000	1.000	-
		Subtotal	0.000	0.000		3.000		0.000		-		0.000	0.000	3.000	N/A

	Prior Years	FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	0.000	0.000		3.000		0.000		-		0.000	0.000	3.000	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 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 9999 / *Congressional Adds*

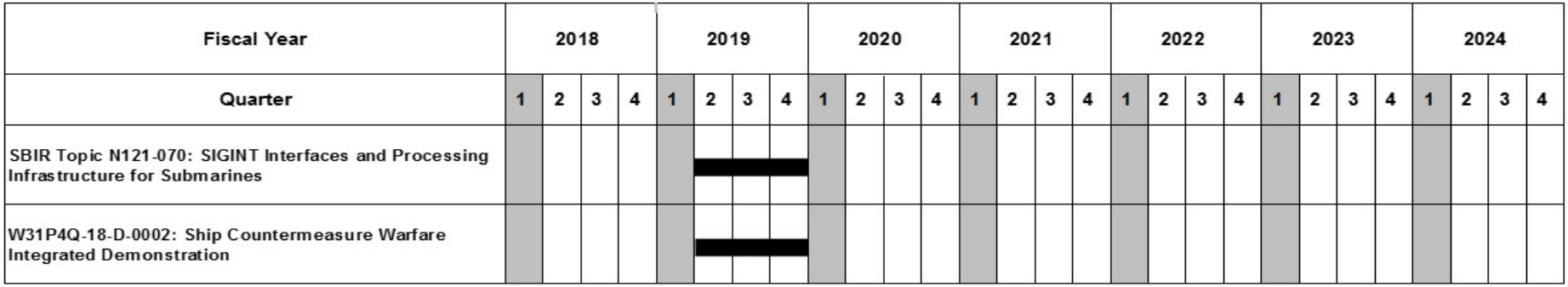

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603562N / *Submarine Tactical Warfare Sys*	**Project (Number/Name)** 9999 / *Congressional Adds*

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	2	2019	4	2019
W31P4Q-18-D-0002: Ship Countermeasure Warfare Integrated Demonstration: W31P4Q-18-D-0002: Ship Countermeasure Warfare Integrated Demonstration	2	2019	4	2019