Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Navy

R-1 Program Element (Number/Name)

1319: Research, Development, Test & Evaluation, Navy I BA 4: Advanced

PE 0603562N I Submarine Tactical Warfare Sys

Date: March 2019

Component Development & Prototypes (ACD&P)

Appropriation/Budget Activity

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
	Tears	F1 2010	F1 2019	Dase	000	IOlai	F1 2021	F1 2022	F1 2023	F1 2024	Complete	COSI
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.

PE 0603562N: Submarine Tactical Warfare Sys

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Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Navy

Appropriation/Budget Activity

R-1 Program Element (Number/Name)

1319: Research, Development, Test & Evaluation, Navy I BA 4: Advanced Component Development & Prototypes (ACD&P)

PE 0603562N / 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)

Project: 9999: Congressional Adds

Congressional Add: Advanced Submarine Electronic Warfare Systems

	FY 2018	FY 2019
	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.

PE 0603562N: Submarine Tactical Warfare Sys UNCLASSIFIED

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Exhibit R-2A, RDT&E Project Ju	stification:	: PB 2020 N	lavy							Date: Marc	ch 2019	
Appropriation/Budget Activity 1319 / 4					_		t (Number/ arine Tactic	•	Project (N 0770 / Adv		ne) 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.

PE 0603562N: Submarine Tactical Warfare Sys

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Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy				Date: Marc	ch 2019	
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number PE 0603562N / Submarine Taction Sys		Project (N 0770 / Adv	umber/Nan Sub Supp	ne) Equip Prog	
B. Accomplishments/Planned Programs (\$ in Millions, Article Quant	ities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: Advanced Imaging Project Development	Articles:	2.325	2.561	2.279	0.000	2.27
Continue Meteorological Development Complete Low Power Fiber Delivered Laser Range Finder Lab Test and Complete Reduced Cost Fabrication of Optical Sapphire Hyper-hemisphotevelopment Complete Anti-reflective Coating Spherical Domes Lab Test and Continue 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 FY 2020 Base Plans: Complete Sea Test and Continue Meteorological Sensors Development Complete Low Power Fiber Delivered Laser Range Finder and Transition Complete Reduced Cost Fabrication of Optical Sapphire Hyper-hemisphotomplete Anti-Reflective Coating Spherical Domes Test and Continue D Complete Volumetric Atmospheric Modeling Testing and Continue Deve Complete Near Ocean Imaging Through Atmospheric Turbulence Testing 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 & De Planning Test and Transition to Imaging FY 2020 OCO Plans: N/A FY 2019 to FY 2020 Increase/Decrease Statement:	eres Lab Test and Continue e Development elopment ment Test and Continue Development to Imaging eres and Transition to Imaging evelopment lopment g and Continue Development					

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Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy				Date: Marc	ch 2019	
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/ PE 0603562N / Submarine Tactica Sys	•		umber/Nan Sub Supp	•	
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 F and Reduced Cost Fabrication of Optical Sapphire Hyper-hemispheres project						
Title: Advanced Electronic Warfare Support (EW) Project Development	Articles:	1.795 -	1.746	2.278	0.000	2.278
Complete Solid State RADAR Emitter Identification test and Continue Develo Complete EW Digital Direction Finding Lab Test and Continue Development Continue Extremely Wideband Digital Receiver Lab Test and Continue Devel Complete Development Wideband Digitizers (Disarmer) and transition to EW Continue Development Tunable Optical Filters for Radio Frequency (RF)Phot Continue Development Data Transmission using Visible Light Communication Continue Development Ruggedized High Speed Optical Fiber Network Confessional Submarine Electronic Warfare (EW) Systems Complete Disposable Buoy Modular Expendable Decoy enhancements Lab Tomplete Disposable Buoy Modular Expendable Intelligence Surveillance and Continue Development Complete Tethered Buoy Modular Tethered Antenna Lab Test and Continue Complete Tethered Buoy Radio Frequency over Fiber (RFoF) Lab Test and Complete Precision DF Lab Test and Transition to EW Complete Multifunction Apertures (SUBSTAR FNC) Lab Test and Transition to Start Development of Micro Adaptive Training FY19 FNC Start Development of Mast Antenna Coupler	opment tonic Signal Distributions System ns (VLC) for Undersea Platforms ector Interfaces for Next Generation Test and Continue Development d reconnaissance (ISR) Lab Test Development Continue Development					
FY 2020 Base Plans: Complete Lab Test and Transition Solid State RADAR Emitter Identification to Complete EW Digital Direction Finding and transition to EW Complete Extremely Wideband Digital Receiver Lab Test and Transition to E' Complete Tunable Optical Filters for Radio Frequency (RF)Photonic Signal D Complete Data Transmission using Visible Light Comms (VLC) for Undersea Complete Ruggedized High Speed Optical Fiber Network Connector Interface Complete TI-22 Disposable Buoys Modular Expendable Decoy Buoy Enhance	W vistributions System Lab Test #2 Platforms Lab Test es for NEXGEN EW Lab Test					

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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

Navy

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.

PE 0603562N: Submarine Tactical Warfare Sys

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Exhibit R-3, RDT&E	Project C	ost Analysis: PB 2	020 Navy	/								Date:	March 20)19	
Appropriation/Budg 1319 / 4	et Activity	1					ogram Ele 3562N / S					(Numbe i Adv Sub S		p Prog	
Product Developme	nt (\$ in M	illions)		FY 2	018	FY 2	2019	FY 2 Ba		FY 2		FY 2020 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To	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	Continuin
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 Servic	es (\$ in M	illions)		FY 2	018	FY 2	2019	FY 2 Ba		FY 2		FY 2020 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To	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	Continuin
		Subtotal	0.329	0.028		0.028		0.028		-		0.028	Continuing	Continuing	N/A
			Prior Years	FY 2	2018	FY 2	2019	FY 2 Ba		FY 2		FY 2020 Total	Cost To	Total Cost	Target Value of Contract
		Project Cost Totals	21.293	4.120		4.307		4.557		_		4.557	Continuing	Continuing	N/A

Remarks

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Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy Date: March 2019 R-1 Program Element (Number/Name) **Appropriation/Budget Activity** Project (Number/Name) PE 0603562N / Submarine Tactical Warfare 0770 / Adv Sub Supp Equip Prog 1319 / 4 Sys ASSEP Fiscal Year Quarter 2 Imaging Advanced Development 360 Degree Imaging (AMPPM->TOTIM) Transition Start/Stop to Imagir RF Vulnerability Reduction (RAS) (SBIR) N131-033 Transition to Imaging Event Automatic Aircraft Cueing (SBIR) N131-055 Lab Testing Transition Passive Ranging - (SBIR) N121-069 Transition to Imaging GPS Denied Navigation (SBIR) N151-032 Lab Testin Transition to Imaging Submarine Meteorological Sensors (SBIR) N151-038 Lab Testir Sea Testing Transition to Imaging Develop RIF - Spinel Hyper-hemisphere Low Power Fiber Delivered Laser Range Finder (SBIR) Lab Testing ransition to Imaging N161-033 Lab Testing Reduced Cost Fabrication of Optical Sapphire Hyper-Lab Testin Transition to Imagin hemispheres (SBIR) N161-036 Lab Testing Anti reflective Coating Spherical Domes (SBIR) N171-045 Transition to Imaging Develop (SBIR) Volumetric Atmospheric Modeling (STTR) N17A-T018 Transition to Imagin Develop (SBIR) Near Ocean Imaging though Atmospheric Turbulence Transition (SBIR) N181- (TBD) Develop (SBIR) Vulnerability Improvement Transition Imaging Buoy Develop **RCS Treatment** Transition to Imaging Testing aging & SNACS System For Non-Acoustic Control of Signatures (SNACS ransition_to ASSEP Transition to Imaging FNC, FY19 Start) Jump Start Develop (FNC) Type 28/Future Mast Studies PA Electromagnetic Spectrum Sensor System Simulation PA#1 Lab PA#2 Lab Transition to Imaging & Development for Model - Based Mission Planning Develop Fiscal Year 2022 2023 2024 Quarter 3

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy Date: March 2019 R-1 Program Element (Number/Name) Appropriation/Budget Activity Project (Number/Name) 0770 I Adv Sub Supp Equip Prog 1319 / 4 PE 0603562N / Submarine Tactical Warfare Sys **ASSEP** Fiscal Year 2020 2018 2019 2021 2022 2023 2024 2 3 2 3 2 3 3 6 7 2 3 Quarter **Electronic Warfare Advanced Development** Lab Test
Transition to EW Tech Insertions (APB17/19) Enhanced DeInterleavers (SBIR) Start/Stop N121-133 & RIF Event HMI Improvements (SBIR) N151-059 Lab Demo Transition to EW Lab Test Solid State RADAR Emitter Identification N171-043 Phase I Lab Test ► Transition to EW SBIR Develop Tech Insertions (TI18) LPI DF / Localization Lab Test Transition to EW Digital EWR (SBIR) N161-025 Lab Test Transition to EW Develop Lab Test Large Time Bandwidth Reciever ONR SBIR N141-065 Phase Transition to EW Extremely Wideband Digital Receiver NATO Nunn Project with Lab Test NAVAIR and Australia Transition to EW Develop WB Digitizers - DISARMER Lab Test Transition to EW Develop EW Digital Direction Finding (SBIR) N151-059 ab Test Transition to EW RFOF Submarine Mast Integration N2N6 Congressional Plus Lab Demo Transition to EW up Tunable Optical Filters for Radio Frequency (RF) Photonic Lab Test Lab Test Signal Distribution Systems 18.1 SBIR Develop Transition to EW Tech Insertions (TI20) Next Generation EW System Lab Test (Next Generation SIGINT Processing Infrastructure High Speed Transition to EW Backbone), RIF, & OSD funded

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	_				20	19			_			202	21			2022			202	23			2024	
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Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
· · · · · · · · · · · · · · · · · · ·	R-1 Program Element (Number/Name) PE 0603562N / Submarine Tactical Warfare Sys	ject (Number/Name) O I Adv Sub Supp Equip Prog

Schedule Details

	Sta	art	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			

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

	Sta	art	E	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	

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

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

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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	- , (umber/Name) Sub Supp Equip Prog

	Sta	art	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	

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

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Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy	Date: March 2019		
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	St	art	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: Marc	ch 2019		
Appropriation/Budget Activity 1319 / 4						Project (Number/Name) 1739 I Submarine Arctic W/F Development			elopment			
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 2020	FY 2020	FY 2020
		FY 2018	FY 2019	Base	oco	Total
Title: Conduct ICEX and Arctic Transit Mission, ICEX Workup and Training, Ice Camps		9.477	5.067	6.635	0.000	6.635
A	Articles:	-	-	-	-	-
FY 2019 Plans:						
- Conduct Arctic work-up training.						
- Support Arctic deployments, including inter-Fleet transfers, as required by the SUBFOR Commanders.						

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Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy				Date: Marc	ch 2019	
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/I PE 0603562N / Submarine Tactica Sys		Project (N 1739 / Sub			elopment
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantit	ties in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
 Investigate, research, develop and deploy new systems for Arctic submater and Conduct Arctic operations to support ice camp equipment evaluation, systemather training as well as to perform drifting sea ice analysis required to operations. Support testing and tactical development required to improve submarine. Initiate planning, logistics support, procurement, and preparation for ICE. 	stems development, and extreme cold improve drifting sea ice camp Arctic Arctic operability and warfighting.					
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 conduct complex and coordinated operations from a drifting ice station. Lo submarine and camp operations from a drifting ice station that is re-suppli and fixed-wing aviation services, via USTRANSCOM, from temporary infra Slope of Alaska. - Support Arctic deployments, including inter-Fleet transfers, as required be Investigate, research, develop, and deploy new systems for Arctic submarine. Support testing and tactical development required to improve submarine. Conduct Arctic operations to support ice camp equipment evaluation, systemather training, and to also perform drifting sea ice analysis required to inperations.	range for approximately 14 days, ogistically and operationally support ed via contracted commercial rotary astructure and services on the North by the SUBFOR Commanders. arine support. Arctic operability and warfighting. stems development and extreme cold					
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 ICEX events scheduled in FY 2020. These events are schedule on a bier and resources in aviation, personnel, logistics, and operations. FY 2019 is for the events to be conducted in FY 2020. There are no major TACDEV Additional efforts in FY 2020 also include the conduct of Arctic work-up tradeployments to drifting ice floes in the Arctic, and ICEX 2020 post mission	nnial basis and require additional efforts s a planning and development year ICEX events planned in FY 2019. sining, Arctic transit mission, personnel					
Accomplis	hments/Planned Programs Subtotals	9.477	5.067	6.635	0.000	6.63

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Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
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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 A	Arctic deployments	. including inter-Fleet transf	ers and biennial ICEXs.	as required by t	he SUBFOR Commanders.
conduct and cappont	a one acprogramonic	, moraamig miter i leet traner	ore area profittion relation,	ac required by t	no cobi or communicio.

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy

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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 Milli	ons)		FY 2	2018	FY 2	2019	FY 2 Ba	2020 ise		2020 CO	FY 2020 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To	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 Servic	lanagement Services (\$ in Millions)			FY 2	2018	FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To	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	-

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Exhibit R-3, RDT&E	Project C	ost Analysis: PB 2	:020 Navy	/								Date:	March 20	019	
Appropriation/Budg 1319 / 4	et Activity	1					•	ement (N Submarine		•		(Numbe i Submarine	,	//F Develo	opment
Management Servic	es (\$ in M	illions)		FY 2	018	FY 2	019	FY 2 Ba			2020 CO	FY 2020 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To	Total Cost	Target Value of Contract
		Subtotal	1.559	0.100		0.102		0.104		-		0.104	Continuing	Continuing	N/A
			Prior Years	FY 2	018	FY 2	019	FY 2 Ba		FY 2	2020 CO	FY 2020 Total	Cost To	Total Cost	Target Value of Contract
		Project Cost Totals	60.731	9.477		5.067		6.635		-		6.635	Continuing	Continuing	N/A

Remarks

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xhibit R-4, RI ppropriation/ 319 / 4				Profile	e: PB	2020	Navy	<u>/</u>					∃ 060		n Elen N / Su								umbe	er/Nan ne Arci	ne)		/elopi	 men		
	T	FY	2018			FY	2019			FY	2020			FY	2021	T		FY	2022			FY	2023			FY	024	—		
Project 1739	Q1	Q2	Q3	Q4	Q1	Q2		Q4	Q1	Q2	Q3		Q1	Q2		Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3			
ICEX Missions	ICEX 2018 Ping	lack	ICEX 2 Analy Repor	/sis/		ICEX	2020 Pla	anning			Analy Repor	sis/		ICEX	2022 Pla	nning			Analy Repor	sis/		ICEX	2024 PI	anning		A	Ana Repo	2024 lysis/ orting		
		K 2018 CDEV /	TORPE	x)						ICEX 20 (TACDE		_						EX 2022 ACDEV	2 / TORP	EX)	-					CEX 202 TACDE				
lce Camps (Arctic Ocean)	1	ce Can	np 2 018							Ice Car	np 2020							lce Can	np 2022]					Ice Can	p 2024			
Arctic Workup (atsea)														Arctic \	Vorkup															
Arctic Training																Arctic 1	raining													
Arctic Deployment														onio Do	ployme															
(atsea)													AI	cuc De	pioyme															
rctic Transit Mission	1												Ard	tic Tran	sit Miss	ion														
(atsea)																														

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

	Sta	art	Eı	nd
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	PE 0603562N / Submarine Tactical Warfare	, ,	umber/Name) marine Arctic W/F Development
	Sys		

	St	art	Er	nd
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 Ju	Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy													
Appropriation/Budget Activity 1319 / 4		_	am Elemen 62N / Subma	•		(Number/Name) 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 2024	Cost To Complete	Total Cost			
9999: Congressional Adds	0.000	0.000	3.000	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

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Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity	R-1 Program Element (Number/Name)	Project (N	umber/Name)
1319 / 4	PE 0603562N I Submarine Tactical Warfare	9999 I Cor	ngressional Adds
	Sys		
O Other December For the Occurrence (A to Millions)	•		

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

			FY 2020	FY 2020	FY 2020					Cost To	
<u>Line Item</u>	FY 2018	FY 2019	Base	OCO	<u>Total</u>	FY 2021	FY 2022	FY 2023	FY 2024	Complete	Total Cost
• RDT&E/0603562N/0770:	4.120	4.307	4.557	-	4.557	4.718	4.822	4.908	5.004	Continuing	Continuing
Adv Sub Supp Equip Prog • 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

Navy

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.

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
, , , ,	,	- , (umber/Name)
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	Sys		

Product Developme	nt (\$ in Mi	illions)		FY 2	2018	FY 2	2019	FY 2 Ba	2020 ise		FY 2020 OCO				
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To Complete	Total Cost	Target Value of Contract
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
															Target

	Prior Years	FY 2	018	FY 2	:019	FY 2 Ba	 FY 2	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

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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	, ,	umber/Name) ngressional Adds

Fiscal Year		20	18			20	19			20	20			20:	21			202	22			202	23			20:	24	
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
SBIR Topic N121-070: SIGINT Interfaces and Processing Infrastructure for Submarines																												
W31P4Q-18-D-0002: Ship Countermeasure Warfare Integrated Demonstration																												

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity	, ,	- , (umber/Name)
1319 / 4	PE 0603562N / Submarine Tactical Warfare	9999 I Con	ngressional Adds
	Sys		

Schedule Details

	St	art	Е	nd
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