Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Navy											Date: May 2021	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602747N *I Undersea Warfare Applied Res*							
COST ($ in Millions)	**Prior Years**	**FY 2020**	**FY 2021**	**FY 2022 Base**	**FY 2022 OCO**	**FY 2022 Total**	**FY 2023**	**FY 2024**	**FY 2025**	**FY 2026**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	95.251	96.039	57.484	-	57.484	-	-	-	-	-	-
0000: *Undersea Warfare Applied Res*	0.000	55.672	56.039	57.484	-	57.484	-	-	-	-	-	-
9999: *Congressional Adds*	0.000	39.579	40.000	0.000	-	0.000	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

The Undersea Warfare Applied Research Program Element (PE) funds applied research efforts in undersea target detection, classification, localization, tracking, and neutralization. Associated efforts focus on new Anti-Submarine Warfare (ASW) operational concepts that promise to improve wide-area surveillance, detection, localization, tracking, and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship, and air ASW assets. Research focused on understanding the impacts on marine mammals of manmade underwater sound is also conducted in the PE.

The activities described in this PE address future Navy and Marine Corps capabilities needed to maintain maritime superiority and ensure national security. Targeted capabilities are based on input from Naval Research Enterprise stakeholders including combatant commands, Office of the Chief of Naval Operations (OPNAV) and Headquarters Marine Corps and are designed to exploit breakthroughs in science and technology in order to deliver maximum undersea warfighting benefit to our sailors and marines.

Today's Sailors and Marines are enabled by naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Applied Research, which is the systematic study to understand the means to meet a recognized and specific need. Most of the work in this PE can be classified between Technology Readiness Level (TRL) 2 (technology concept and/or application formulation) and TRL 4 (component and/or breadboard validation in laboratory environments).

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Navy	Date: May 2021
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602747N *I Undersea Warfare Applied Res*

B. Program Change Summary ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	98.075	56.397	57.518	-	57.518
Current President's Budget	95.251	96.039	57.484	-	57.484
Total Adjustments	-2.824	39.642	-0.034	-	-0.034
• Congressional General Reductions	-	-0.358			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	40.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.118	0.000			
• SBIR/STTR Transfer	-2.706	0.000			
• Program Adjustments	0.000	0.000	0.129	-	0.129
• Rate/Misc Adjustments	0.000	0.000	-0.163	-	-0.163

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2020	FY 2021
Project: 9999: *Congressional Adds*		
Congressional Add: *Navy and academia submarine partnerships*	9.653	0.000
Congressional Add: *Machine discovery and invention*	3.861	0.000
Congressional Add: *Instrumented tow cable*	4.827	0.000
Congressional Add: *Navy undersea warfare science and technology strategy*	1.931	0.000
Congressional Add: *Undersea sensing and communications*	4.827	5.000
Congressional Add: *Energetics and warhead technology development*	7.723	0.000
Congressional Add: *Autonomous undersea robotics systems*	6.757	0.000
Congressional Add: *Cross Domain Autonomy for Persistent Maritime Operations*	0.000	10.000
Congressional Add: *Partnerships for Undersea Vehicle Research*	0.000	14.000
Congressional Add: *Resident Undersea Autonomous Robotics*	0.000	11.000
Congressional Add Subtotals for Project: 9999	39.579	40.000
Congressional Add Totals for all Projects	39.579	40.000

Change Summary Explanation

Schedule: Not applicable.

Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Navy	Date: May 2021
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602747N *I Undersea Warfare Applied Res*

Technical: Not applicable.

Funding: No significant change.

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy			Date: May 2021
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602747N / *Undersea Warfare Applied Res*	Project (Number/Name) 0000 / *Undersea Warfare Applied Res*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
0000: *Undersea Warfare Applied Res*	0.000	55.672	56.039	57.484	-	57.484	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This PE funds applied research efforts in undersea target detection, classification, localization, tracking, and neutralization. Associated efforts focus on new ASW operational concepts that promise to improve wide-area surveillance, detection, localization, tracking, and attack capabilities against quiet adversary submarines operating in noisy and cluttered shallow water environments. Related efforts are aimed at leveraging technologies that will protect the country's current capital investment in surveillance, submarine, surface ship, and air ASW assets.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: Anti-Submarine Warfare (ASW) Distributed Search	15.107	14.351	14.722	0.000	14.722
Description: ASW Distributed Search focuses on the development of technologies for the tactical search for undersea targets ranging from hours to weeks, using automated sensor systems deployed around operating areas, including along key transit routes to protect naval/maritime forces, around temporarily fixed sea base regions and naval force operating areas, or around fixed defensive regions and areas of interest, such as key US/Allied ports. "Search" is conducted in concentrated areas, typically exploiting cues received from surveillance systems. The objective is to develop rapidly deployable systems employing automated detection and classification capabilities for use in both shallow and deep water operating environments. Related efforts include the development of distributed systems; Unmanned Undersea Vehicle-based and affordable off-board deployable sensing systems employing persistent detection concepts and components; and active acoustic sensing and processing techniques, navy-unique transduction and underwater networking technologies. These efforts provide an extended reach of organic platform-based systems through the use of new sensor concepts, improved materials for advanced sensors, optimized deployment, employment, and automated operation of distributed sensor fields. ***FY 2021 Plans:*** - Active Sonar: Conduct development of advanced signal and information processing for high duty cycle active sonar. Further development of concepts for next-generation active sonar system automation, leveraging the latest advances in machine learning and artificial intelligence. Initiate non-acoustic, orthogonal concepts that complement and augment active sonar concepts.					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Sensors: Maintain applied research in improved sensor technology to extend the capabilities of platform-based systems as well as innovative sensor technology for off-board and rapidly deployable systems. - Signal Processing: Conduct research in characterization of and signal processing to control reverberation, clutter, and noise; characterization of target radiation and scattering physics for all threat submarines; physics-based detection and classification algorithms with automation where possible; and knowledge and exploitation of the complex operational environment. ***FY 2022 Base Plans:*** - Active Sonar: Continue development of advanced signal and information processing for high duty cycle active sonar. Further development of concepts for next-generation active sonar system automation, leveraging the latest advances in machine learning and artificial intelligence. Continue non-acoustic, orthogonal concepts that complement and augment active sonar concepts. - Sensors: Continue applied research in improved sensor technology to include both passive and active acoustic and optical sensing to extend the capabilities of platform-based systems as well as innovative sensor technology for off-board and rapidly deployable systems. - Signal Processing: Continue development of advanced signal and information processing for high duty cycle active sonar. Continue to leverage advances in machine learning, e.g. deep learning, to improve performance in clutter type classification and clutter/target discrimination in current active sonar systems. Continue to leverage advances in artificial intelligence, with the objective to develop next-generation intelligent active sonar systems that optimally adapt operating parameters for the operating environment. - Initiate development of technologies and techniques for exploiting structural acoustic vulnerabilities of adversary undersea platforms conducting an at sea trial. - Initiate efforts that will lead to optimized sensing and behaviors by adapting in dynamic and uncertain environments; cooperative vehicle autonomy with increased endurance; data exfiltration and networking to expand reach; next generation sensors (acoustic and non-acoustic); adaptive, autonomous technologies to detect, classify, and track underwater mobile threats. ***FY 2022 OCO Plans:***					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** No significant increase from FY21 to FY22					
Title: Anti-Submarine Warefare (ASW) Precision Localization ***Description:*** ASW Precision Localization focuses on the development and demonstration of technologies which use information from surveillance or search systems to determine an area of uncertainty (AOU) relative to target range, bearing, and depth adequate to handoff to an attack system. Precision Localization employs non-acoustic techniques such as magnetic and optical sensing to highly localize submerged threats. The objective is to increase magnetic sensor range and robustness, enable deployment on Unmanned Air Vehicles (UAVs), and increase optical sensing search rates. Efforts include the development of non-traditional tracking and advanced magnetic and electric field sensors and processing. These technologies will provide a decreased AOU size thus enabling the effective use of smaller, more versatile torpedoes as well as increased performance gain in detection, targeting, tracking/trailing, and homing via target acquisition and covert prosecution. ***FY 2021 Plans:*** - Precision Localization: Conduct research on advanced sensing modalities and sampling approaches. Investigate alternative methods for Precision Localization leveraging magnetic and electric field sensing technologies and incorporating alternative technologies and approaches. - Sensors: Further research into novel methods to develop smaller and power efficient, high performance magnetic, electric field and novel sensors. Conduct research on advanced concepts for processing arrays of independent sensors to create adaptive information theoretic sensor systems. Initiate applied research into information theoretic optical sampling and telemetry characteristics to better support sensor performance and data integrity; improve the effectiveness of photonic sensor operations across the air-water interface; and extend the distance optical sensors can effectively operate within the water column. - Remote and Optical Sensing: Maintain research into remote methods of sensing target signatures. Continue research on optical sensing for precision localization and to better exploit the information capacity available in photonic systems to increase sensor performance.	3.390	3.447	3.528	0.000	3.528

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Magnetic and Electric sensing: Concluded applied research on classical magnetic and electric field sensing. ***FY 2022 Base Plans:*** -Precision Localization: Continue research on advanced sensing modalities and sampling approaches. Investigate alternative methods for Precision Localization leveraging magnetic and electric field sensing technologies and incorporating alternative technologies and approaches. -Sensors: Continue research into novel methods to develop smaller and power efficient, high performance magnetic, electric field, acoustic, and novel sensors. Continue research on advanced concepts for processing arrays of independent sensors to create adaptive information theoretic sensor systems. Continue applied research into information theoretic optical sampling and telemetry characteristics to better support sensor performance and data integrity; improve the effectiveness of photonic sensor operations across the air-water interface; and extend the distance optical sensors can effectively operate within the water column. -Remote and Optical Sensing: Continue research into remote methods of sensing target signatures. Continue research on optical sensing for precision localization and to better exploit the information capacity available in photonic systems to increase sensor performance. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** No significant increase from FY21 to FY22					
Title: Anti-Submarine Warfare (ASW) Surveillance ***Description:*** ASW Surveillance focuses on improving detection, classification, and localization capabilities in large ocean areas relative to the capabilities of existing ASW surveillance systems. The related technologies support the conduct of covert, wide-area surveillance ranging from one day to six months. The objectives are to develop and demonstrate technologies that provide clandestine indications and warnings in far forward and contested operating areas, and in complex operational environments against all submarine threats, including new threats with unknown target signatures and tactics. Covertness implies use of non-observable platforms and/or deployed automated sensors employing passive sonar, or other non-detectable methods. The surveillance process includes initial detection and classification. Efforts include the development of Unmanned Undersea Vehicle-based and affordable, off-board deployable sensing systems employing a wide variety of surveillance concepts and components. These efforts focus on alternative detection phenomena, vector/tensor	21.668	22.474	23.093	0.000	23.093

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
sensors, automated acoustic processing, more compact and longer lasting power sources, and high bandwidth, acoustic communications links. ***FY 2021 Plans:*** - Sonar: Conduct signal processing related research to develop artificial intelligence technology providing optimized sonar system line-ups that adjust themselves in real time to the current undersea environment. - Sensors: Conduct studies to improve performance of acoustic vector sensors, vector magnetometers, electrochemical sensors and three-axis magnetometers. - Underwater Vehicle Propulsion: Conduct development of approaches for fluid-loaded elastic structures and soft-bodied unmanned underwater vehicle propulsion. - Signal Processing: Further investigate applicable non-acoustic methods of detection and classification of ultra-quiet, low-Doppler submarines in complex operating environments. Initiate applied research to exploit recent advances in basic / theoretical computer science to efficiently implement signal processing and artificial-intelligence algorithms using mathematical approaches including randomized methods. ***FY 2022 Base Plans:*** - Sonar: Continue signal processing related research to develop artificial intelligence technology providing optimized sonar system line-ups that adjust themselves in real time to the current undersea environment. - Sonar: Initiate exploitation of the information content of ambient noise, creating novel tactical detection methods that exploit ambient noise information content and conducting at sea measurements to validate. - Sonar: Initiate development and assessment of signal approaches for low complexity sonars, focusing on passive analysis and the generation of actionable warnings. Validate single processing approaches using at sea data. - Sensors: Continue studies to improve performance of acoustic vector sensors, vector magnetometers, electrochemical sensors and three-axis magnetometers.					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Sensors: Initiate development of automation approaches that will modernize undersea passive acoustic detection and classification techniques conducting a major at sea trial to collect data for algorithm training and assessment. - Underwater Vehicle Propulsion: Continue development of approaches for fluid-loaded elastic structures and soft-bodied unmanned underwater vehicle propulsion. - Underwater Vehicle Propulsion: Initiate development of technologies for a solar sea glider focused on develop a wavelength tailored photovoltaic cell with selectable layers for use at surface and sub-surface conditions and begin to look at mitigation approaches to bio-fouling. - Signal Processing: Continue investigating applicable non-acoustic methods of detection and classification of ultra-quiet, low-Doppler submarines in complex operating environments. Initiate applied research to exploit recent advances in basic / theoretical computer science to efficiently implement signal processing and artificial-intelligence algorithms using mathematical approaches including randomized methods. - Initiate efforts that will lead to optimized sensing and behaviors by adapting in dynamic and uncertain environments; cooperative vehicle autonomy with increased endurance; data exfiltration and networking to expand reach; next generation sensors (acoustic and non-acoustic); adaptive, autonomous technologies to detect, classify, and track underwater mobile threats; and new processing techniques which increase performance and expand the tactical utility of current systems. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** No significant increase from FY21 to FY22					
Title: Marine Mammals ***Description:*** The goal of the Marine Mammals and Biology activity focus is to better understand and characterize the effects of underwater sounds produced by Navy acoustic sources on marine mammals. Studies address characterizing marine mammal and their ecosystems, quantifying effects of sound exposure on marine mammals, and improving the ability to monitoring and detect marine mammals in the open ocean. Research results supports Navy environmental compliance information needs and facilitates acquiring Letter of	2.409	2.449	2.507	0.000	2.507

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Authorizations from NOAA regulators that enable all Navy training and testing operations, and the development of appropriate state-of-the-art mitigation measures. The marine mammals research conducted in this Program Element (PE) represents part of a total effort executed in coordination with complementary research performed in PE 0602435N Ocean Warfighting Environment Applied Research. ***FY 2021 Plans:*** FY 2021 efforts include applied research in areas including monitoring and detection, integrated ecosystem, and effects of Anti-Submarine Warfare (ASW) sonar on marine mammals. - Passive Acoustic Monitoring: Further research efforts on passive acoustics and other technology supporting wide area surveillance, including the development and testing of new autonomous hardware platforms and signal processing algorithms for detection, classification, and localization of marine mammals. Maintain research using animal tagging and passive acoustic monitoring to quantify behaviors, movement and distribution of marine mammals relative to key environmental properties and sonar exposure, both incidental and experimental. - Sonar Exposure: Conduct research to quantify the behavioral effects to potentially population-level consequences of sonar exposure on marine life to develop risk criteria for Navy's sound effects modeling, and develop quantitative inputs for modeling biologically significant effects on marine mammal populations. Navy sound effects modeling is used in Environmental Impact Statements, and subsequent Letters of Authorization issued by the NOAA regulator that enable all Navy ASW exercises and testing. - Marine Mammals: Further research to design equipment and capability to quantify the gas management and kinetics in marine mammals to evaluate the mechanisms that enable marine mammals to dive to deep. - Sound Reception Mechanisms in Whales: Pursue research to advance our understanding of sound reception mechanisms in large whales including the anatomy surrounding the ear and the whole head to improve and validate finite element models of sound propagation through various tissues. - Marine Mammal Behavior: On going research into the stress response of marine mammals to ASW sonar exposure with an emphasis on quantifying the effects of prolonged exposure effects on immune system suppression, reproductive failure, accelerated aging, and slowed growth. Conduct research on potential effects					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
of Navy Anti-Submarine Warfare (ASW) sonar sources on marine mammal behavior, life functions, vital rates, and population level effects. The goal is to understand and quantify the effects of naval activities on species or stocks of marine mammals, including effects on annual rates of recruitment and survival. - Environmental Compliance: Maintain research to provide tools to support environmental compliance efforts and decision making related to how marine mammals can be affected by anthropogenic sounds. ***FY 2022 Base Plans:*** Efforts include applied research in areas including monitoring and detection, integrated ecosystem, and effects of Anti-Submarine Warfare (ASW) sonar on marine mammals. -Passive Acoustic Monitoring: Continue research efforts on passive acoustics and other technology supporting wide area surveillance, including the development and testing of new autonomous hardware platforms and signal processing algorithms for detection, classification, and localization of marine mammals. Continue research using animal tagging and passive acoustic monitoring to quantify behaviors, movement and distribution of marine mammals relative to key environmental properties and sonar exposure, both incidental and experimental. -Sonar Exposure: Continue research to quantify the behavioral and physiological effects to potentially population-level consequences of sonar exposure on marine life to develop risk criteria for Navy's sound effects modeling, and develop quantitative inputs for modeling biologically significant effects on marine mammal populations. Navy sound effects modeling is used in Environmental Impact Statements, and subsequent Letters of Authorization issued by the NOAA regulator that enable all Navy ASW exercises and testing. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** No significant increase from FY21 to FY22					
Title: Undersea Weaponry ***Description:*** Undersea Weaponry focuses on the development of technologies for current and next-generation, offensive and defensive weapons capable of engaging submarines, surface ships and threat torpedoes. Specific efforts focus on increasing probability of kill and probability of counter-kill by improving sensor performance, engagement tactics, vehicle propulsion and warhead lethality. New weapon and delivery concepts are being assessed.	13.098	13.318	13.634	0.000	13.634

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 0000 / *Undersea Warfare Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Detailed information regarding Undersea Weaponry Applied Research program plans and objectives is at a higher classification. ***FY 2021 Plans:*** - Undersea Weaponry: Conduct applied research related to critical Science and Technology (S&T) for advanced warhead and fuzing concepts, characterization of torpedo fuel and new fuel formulations, small-scale weapon concepts, dynamic testing of vehicles to assess kinematics, and propulsion systems for undersea vehicles and platforms. ***FY 2022 Base Plans:*** Undersea Weaponry: Continue applied research related to critical Science and Technology (S&T) for advanced warhead and fuzing concepts, characterization of torpedo fuel and new fuel formulations, small-scale weapon concepts, dynamic testing of vehicles to assess kinematics, and power and propulsion systems for undersea vehicles and platforms. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** No significant increase from FY21 to FY22					
Accomplishments/Planned Programs Subtotals	55.672	56.039	57.484	0.000	57.484

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy			Date: May 2021
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602747N / *Undersea Warfare Applied Res*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	39.579	40.000	0.000	-	0.000	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

Efforts for Undersea Warfare Applied Research

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021
Congressional Add: Navy and academia submarine partnerships ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** N/A	9.653	0.000
Congressional Add: Machine discovery and invention ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** N/A	3.861	0.000
Congressional Add: Instrumented tow cable ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** N/A	4.827	0.000
Congressional Add: Navy undersea warfare science and technology strategy ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** N/A	1.931	0.000
Congressional Add: Undersea sensing and communications ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** Regional research teams from several universities will jointly pursue applied research related to oceanographic processes, models and innovative technologies. Peer-reviewed scientific publications and final technical reports are the anticipated deliverables.	4.827	5.000
Congressional Add: Energetics and warhead technology development	7.723	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602747N / *Undersea Warfare Applied Res*	**Project (Number/Name)** 9999 / *Congressional Adds*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021
FY 2020 Accomplishments: N/A ***FY 2021 Plans:*** N/A		
Congressional Add: Autonomous undersea robotics systems ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** N/A	6.757	0.000
Congressional Add: Cross Domain Autonomy for Persistent Maritime Operations ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** The Office of Naval Research has Task Force Ocean grants in place with University of California, Massachusetts Institute of Technology, Woods Hole Oceanographic Institution, University of Rhode Island, and University of New Hampshire, as well as other ongoing efforts with CA, MA, and RI institutions to continue the Task Force Ocean research program.	0.000	10.000
Congressional Add: Partnerships for Undersea Vehicle Research ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** Develop technology that will enhance the undersea warfare domain that will strengthen collaboration between UCONN, URI, Navy Research laboratories, academia, and industry.	0.000	14.000
Congressional Add: Resident Undersea Autonomous Robotics ***FY 2020 Accomplishments:*** N/A ***FY 2021 Plans:*** The OSU/APL-UW effort will develop critical technologies and at-sea testing to develop an undersea testbed for resident autonomy.	0.000	11.000
Congressional Adds Subtotals	39.579	40.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A