Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Navy	Date: May 2017
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy* / BA 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601152N / *In-House Lab Independent Res*

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
Total Program Element	0.000	18.978	18.508	19.438	-	19.438	19.434	19.440	19.441	19.829	Continuing	Continuing
0000: *In-House Lab Independent Res*	0.000	18.978	18.508	19.438	-	19.438	19.434	19.440	19.441	19.829	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program element (PE) sustains U.S. Naval Science and Technology (S&T) superiority by providing new technological concepts for the maintenance of Naval power and national security, and by helping to avoid scientific surprise while exploiting scientific breakthroughs and providing options for new Future Naval Capabilities (FNCs). The Department of the Navy (DON) component responds to S&T directions of the Naval S&T Strategic Plan for long term Navy and Marine Corps improvements and is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command and the Marine Corps Combat Development Command. It enables technologies that significantly improve the Joint Chiefs of Staff's Future Joint Warfighting Capabilities. The In-house Laboratory Independent Research (ILIR) program also adds increased emphasis to the revitalization of the scientist and engineer workforce component at the Navy's Warfare Centers and Laboratories by attracting superior candidates and retaining our best members through the provision of exciting and meaningful work.

This PE addresses DON Basic Research, which includes scientific study and experimentation directed toward increasing knowledge and understanding in national-security related aspects of physical, engineering, environmental, and life sciences, and is the core of Discovery and Invention. Basic research projects are developed, managed, and related to more advanced aspects of research in some hundred-plus technology and capability-related 'thrusts', which are consolidated in thirteen research focus areas: Power and Energy; Operational Environments; Maritime Domain Awareness; Asymmetric and Irregular Warfare; Information, Analysis and Communication; Power Projection; Assure Access and Hold at Risk; Distributed Operations; Naval Warfighter Performance and Protection; Survivability and Self-Defense; Platform Mobility; Fleet/Force Sustainment; Affordability, Maintainability and Reliability.

This portion of the DON Basic Research Program provides participating Naval Warfare Centers and Laboratories with funding for: basic research to support the execution of their assigned missions; developing and maintaining a cadre of active researchers who can distill and extend results from worldwide research and apply them to solve Naval problems; promoting hiring and development of new scientists; and encouragement of collaboration with universities, private industry, and other Navy and Department of Defense laboratories.

In-house Laboratory Independent Research (ILIR) efforts are selected by Naval Warfare Centers/Lab Commanding Officers and Technical Directors near the start of each Fiscal Year through internal competition. Efforts typically last three years, and are generally designed to assess the promise of new lines of research. Successful efforts attract external, competitively awarded funding. Because the Warfare Centers and Labs encompass the full range of naval technology interests, the scope of ILIR topics roughly parallels that of PE 0601153N, Defense Research Science.

Due to the number of efforts in PE 0601152N, the programs described herein are representative of the work included in this PE.

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B. Program Change Summary ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Previous President's Budget	19.126	18.508	19.438	-	19.438
Current President's Budget	18.978	18.508	19.438	-	19.438
Total Adjustments	-0.148	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.148	0.000			
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy			Date: May 2017
Appropriation/Budget Activity 1319 / 1	**R-1 Program Element (Number/Name)** PE 0601152N / *In-House Lab Independent Res*	**Project (Number/Name)** 0000 / *In-House Lab Independent Res*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
0000: *In-House Lab Independent Res*	0.000	18.978	18.508	19.438	-	19.438	19.434	19.440	19.441	19.829	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project sustains U.S. Naval S&T superiority, provides new technological concepts for the maintenance of naval power and national security, and mitigates scientific surprises, while exploiting scientific breakthroughs and providing options for new Future Naval Capabilities (FNC's). It responds to S&T directions of the Naval S&T Strategic Plan for long term Navy and Marine Corps improvements. It is in consonance with future warfighting concepts and doctrine developed at the Naval Warfare Development Command (NWDC) and the Marine Corps Combat Development Command (MCCDC), and enables technologies that significantly improve the Joint Chiefs of Staff's Future Joint Warfighting Capabilities.

This portion of the DON Basic Research Program provides participating Naval Warfare Centers and Laboratories with funding for basic research to support the execution of their assigned missions, for developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to naval problems, to promote hiring and development of new scientists, and to encourage collaboration with universities, private industry, and other Navy and Department of Defense laboratories.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Title: IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	16.528	16.065	16.873	0.000	16.873
FY 2016 Accomplishments: Continued FY 2015 ILIR projects that are intended to be approximately three years in length to research topics including: Structural materials, functional materials, maintenance reduction, hydrodynamics, power generation, energy conservation and conversion, littoral geosciences, optics, and biology; marine mammals; ocean acoustics; and autonomous systems. - Continued research for polymer materials to understand improved helmet blast protection. - Continued fundamental research for composite materials for reduced signature for undersea vehicles. - Continued research for the fundamental understanding of graphene type Radio Frequency (RF) Antennas. - Continued research for complex unmanned sensor networks. - Continued fundamental research for the understanding of optimization of undersea sensor distribution in littoral environments. - Continued research for understanding effects of energetic materials under high pressure environment. - Continued research on Operational Fatigue of Warfighters due to Stress Environments. - Continued research on Human Gesture and Computer Interface and Functionality.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continued research framework for Efficient Quantum Computing. - Continued research for Autonomous Routing of Unmanned Vehicles. - Continued fundamental research for undersea imaging and analysis. - Continued research for modeling super-cavitation of Advanced Propulsor Designs. - Continued research for Predictive Performance Modeling of Advanced Naval Hull Designs. - Continued research for Design and Performance of High Speed Naval Vessels. - Continued research for Advanced Smart Wireless Cooperative Vehicular Network. - Continued research for Undersea Laser Communication and Identification in Littoral Environments. - Sensing, diagnostics, and detectors; navigation and timekeeping; nano electronics; real time targeting, Electro-Optical/InfraRed (EO/IR) electronics; EO/IR electronic warfare; and EO/IR sensors for surface and subsurface surveillance. - Undersea weaponry, energetic materials and propulsion, directed energy, and TeraHertz Time-Domain Spectroscopy (THz-TDS) technology that addresses overseas contingency operations and Counter Improvised Explosive Device (C-IED) detection by detecting and spectroscopically identifying military and home-made explosives and formulations. - Biosensors, biomaterial, bioprocesses; marine mammals; casualty care management, undersea medicine; human factors and organizational design; manpower, personnel and advanced cockpit; and operational training and education. These efforts are coordinated with the Navy Medical Research Center (NMRC). - Mathematical foundation and computational theory and tools for design communications, decision support theory, algorithm and tools, information assurance, secure and reliable infrastructure for command and control, mathematical optimization for optimal resource allocation and usage, modeling and computational propagation, seamless, robust connectivity and networking and cyber warfare. - Novel hull forms, materials, structures and signatures; and virtual shaping concepts for structures and platforms. - Littoral geosciences, optics, and biology; marine mammals; ocean acoustics; and autonomous systems. - Naval Materials by Design and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Electromagnetic Gun and Sea Basing, and National Naval Responsibility initiatives in Undersea Weaponry and Naval Engineering. - Battlespace Awareness and Intelligent Naval Sensors, Innovative Naval Prototype initiatives in Persistent Surveillance and Sea Basing, and the National Naval Responsibility in Undersea Weaponry. - Command and Control and connectivity research.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Initiated FY 2016 ILIR projects that are intended to be approximately three years in length to research topics including : - Structural materials, functional materials, maintenance reduction, hydrodynamics, power generation, energy conservation and conversion. - Novel hull forms, materials, structures and signatures; and virtual shaping concepts for structures and platforms. - Littoral geosciences, optics, and biology; marine mammals; ocean acoustics; and autonomous systems. - Tailoring Instruction to the Individual: Investigating the Utility of Trainee Aptitudes for use in Adaptive Training. - Research to Improve Situational Awareness Using Learned Representations and Autonomous Systems. - Developing Novel Propellants for Solid Ramjet Application. - Anomalous Capacity Loss and Recovery in Lead Acid Batteries Following Rapid Pulsed Discharge Power and Energy. - Research of n+InP as a Possible New Semiconductor Material for Fast Neutron Spectroscopy. - Polarimetric Radar Cross Section Control. - Broadband Prewhitening Filtering Framework to Improve Beamforming Detection Performance inLinear Arrays under reduced Snapshot Support Conditions. - Automated Storytelling: Co-clustering of Topic Models for Topic Detection and Tracking - Developing the Theory of Superabsorption. - Topological Methods for the Analysis of Big Data. - Neutralization Using Air-Deployable Self-surveying UUV - Optimized Waterspace Management & Scheduling for Heterogeneous Teams of Autonomous Vehicles. - Secure Underwater Communications Study for the Advanced Undersea Weapons (AUWS). - Acoustic Reception and Transmission in High Speed Flows. - Beamforming with Arrays of Sensor Elements with Uncertain Location. - Develop Design, Testing, and Analysis of Zero Poisson Ratio Metamaterials - Beam Space Multiple Input Multiple Output. - Graphene Broadband Infrared Light-Emitting Devices. - Machine Learning of Autonomous Vehicle Tactics through Human Evaluation. - Nomad: A Hybrid-Cloud Aware High Assurance and Availability Cloud Service. - Nonvolatile and Cryogenic Compatible Quantum Memory Devices. - Stochastic Compiler Hacks as Software Immunization Mechanisms (SCHSIM).					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Energy Harvesting for Future E					
FY 2017 Plans: - Continue all efforts of FY 2016, less those noted as completed above. - Continue ILIR projects started in FY 2016. - Complete FY 2015 ILIR projects which were three years in duration. - Initiate FY 2017 ILIR projects that are to be approximately three years in length. - Construct Correspondence of Physiological and Subjective Measures of Hypoxia - Development and Validation of a Dynamic Environmental Severity Index (d-ESI) Metric - Electrodeposition of Aluminum Alloys from Air-stable - Microfocus Computed Tomography Research - Quantum Synchronization of Unequal Clocks; Sensors and Electronics - Verification of Carrier-based Autonomous Systems (VOCAS) - Development of Multifunctional ZnO Nanocarriers for Controlled and Enhanced Biofilm Dispersion - Decrements in Skeletal Muscle Performance & Mitochondrial Function - Development of a Novel Bacteriophage Therapeutic Treatment Against Methicillin Resistant Staphylococcus aureus (MRSA) and Multi-Drug Resistant Pseudomonas Aeruginosa - Impact of Physiological Adaptations Associated with Diving on Blood and Tissue Dosimetry of Xenobiotics - Surface Chemistry Evolution in High-power/High-energy Lithium-ion Battery (LIB) Cathodes - Performance Improvement in Iron Fluoride Conversion Materials Through Copper Doping - Dynamically Driven Modal Effects on Load Combinations that Affect Failure on Multi-Hull Structures - Development of Multifunctional Materials with Reconfigurable Electromagnetic Properties - Active Flow Control by Sweeping Jets - Algorithm Design for Mixed-Radix Polynomial Arithmetic - Applications of the Aharonov Ansatz to Sensor Problems - Catalytic Self-Decontaminating Cloth Prepared Through Self-Assembly - Fault Tolerant Methods for Scientific Computing - Hypersonic, Dissociating Flow Over an Elastically Deforming Airfoil at Sea-Level - Theoretical Foundations of System Engineering - Mechanistic and Kinetic Investigations of the Combustion of Reactive Materials via Time-Resolved - Microscale Modeling of Multiphase Interactions in Energetic Systems - High-Density Metal Binder Compositions for Hard-Target Defeat - Fluid Structure Interaction Numerical Modeling					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Unsupervised Image and Data Analysis - Seawater Flow in Electric and Magnetic Fields - Optimal UUV Design for Energetic Environments - 3D Reconstruction From Similarity Matrices - Hull; A Higher Order Shear Deformation Model of a Curved Beam - Observer Modeling Approach to Understanding Decision Making in Submarine Operations - Constitutive Laws for the Design of Metallic Foams - Cooperative Search in Autonomous Swarms with Restricted Communication - Field Programmable Neural Array for Neural Information Processing of Underwater Sensing Applications - Frequency-varying Dielectric Composites - Investigation of Transduction Physics of Distributed Fiber Sensor Systems Embedded in a Fully Elastic medium - Lift Production Using Differential Cavity Ventilation on a Symmetric Hydrofoil - Multi-level Linear Algebra; Information and Decision Support - Observation and Modeling of Natural Collective Behavior; Autonomous Systems - Theory of Nearfield Spherical Antenna Measurements Over Seawater - Undersea Acoustic Superiority - Short Pulse Laser Induced Plasma Filaments for Extended Covert Communications - Voltage-Tunable Wavelength-Agile 2D-Material-Based Light Emitting Diodes ***FY 2018 Base Plans:*** Continue In-house Laboratory Independent Research (ILIR) projects that enables laboratories to sponsor focused, high-risk research with potential high payoffs to the Navy and Marine Corps on a discretionary basis. ***FY 2018 OCO Plans:*** N/A					
Title: SCIENCE TECHNOLOGY ENGINEERING AND MATH (STEM) EFFORTS AT NAVY LABS ***Description:*** This effort will support both the Science and Engineering Apprenticeship Program (SEAP) and the Naval Research Enterprise Intern Program (NREIP) summer programs to encourage participating students to pursue science and engineering careers, to further their education via mentoring by laboratory personnel and their participation in research, and to make them aware of DON research and technology efforts, which can lead to employment within the DON. Participating students will spend eight to ten weeks during the summer doing research at approximately 19 to 20 DON laboratories. Participants will receive a stipend distributed by the Contractor. The stipend is a monthly allowance paid to interns for their participation in the research efforts.	2.450	2.443	2.565	0.000	2.565

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
FY 2016 Accomplishments: - Continued Naval Research Enterprise Intern Program (NREIP) to support undergraduate and graduate students performing Navy-related research at Naval Warfare Centers under the supervision and mentorship of DON Scientists, thus exposing them to interesting and challenging work done at the centers. NREIP is a continuing Navy education program. - Continued Science and Engineering Apprenticeship Program (SEAP) supporting high school student programs. - Continued Science, Technology, Engineering and Mathematics (STEM) projects that are intended to be approximately three years in length. Projects selected for STEM funding will focus on engaging and educating future Naval scientists and engineers and incorporating naval relevance, diversity, and STEM best practices. These efforts complement and support the ongoing independent research, education and outreach efforts taking place at the naval laboratories. ***FY 2017 Plans:*** - Continue all efforts of FY 2016. ***FY 2018 Base Plans:*** Continue to provide opportunities for students to participate in research at DON laboratories during the summer via the Naval Research Enterprise Internship Program (NREIP) program for undergraduate and graduate students and the Scientist and Engineering Apprenticeship Program (SEAP) Program for high school students. ***FY 2018 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	18.978	18.508	19.438	0.000	19.438

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

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E. Performance Metrics

The ILIR initiative seeks to improve the quality of defense research conducted predominantly through the Naval Warfare Centers/Laboratories. It also supports the development of technical intellect and education of engineers and scientists in disciplines critical to national defense needs through the development of new knowledge in a military laboratory environment. Initial research focus is often conducted in an unfettered environment since it is basic research, but many projects focus on applying recently developed theoretical knowledge to real world military problems with the intention of developing new capabilities and improving the performance of existing systems. Individual project metrics then become more tailored to the needs of specific applied research and advanced development programs. The National Research Council of the National Academies of Science and Engineering's Congressionally directed "Assessment of Department of Defense Basic Research" concluded that the Department of Defense is managing its basic research program effectively.