Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Navy											Date: May 2017	
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602123N *I Force Protection Applied 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	174.447	158.745	125.557	-	125.557	124.007	121.863	121.922	124.398	Continuing	Continuing
0000: *Force Protection Applied Res*	0.000	155.137	158.745	125.557	-	125.557	124.007	121.863	121.922	124.398	Continuing	Continuing
9999: *Congressional Adds*	0.000	19.310	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	19.310

A. Mission Description and Budget Item Justification

The efforts described in this program element (PE) are based on investment directions as defined in the Naval S&T Strategic Plan approved by the S&T Corporate Board (20 Jan 2015). This strategy is based on needs and capabilities from Navy and Marine Corps guidance and input from the Naval Research Enterprise (NRE) stakeholders (including the Naval enterprises, the combatant commands, the Chief of Naval Operations (CNO), and Headquarters Marine Corps). It provides the vision and key objectives for the essential science and technology efforts that will enable the continued supremacy of U.S. Naval forces in the 21st century. The Strategy focuses and aligns Naval S&T with Naval missions and future capability needs that address the complex challenges presented by both rising peer competitors and irregular/asymmetric warfare.

This PE addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. It supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial, and air) and the protection of those platforms. The goal is to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability. Within the Naval Transformational Roadmap, this investment directly supports the Theater Air and Missile Defense transformational capability required by Sea Shield and the Ship to Objective Maneuver key transformational capability. This is accomplished by improvements in platform offensive performance, stealth, and self-defense.

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

B. Program Change Summary ($ in Millions)	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**
Previous President's Budget	178.616	158.745	164.678	-	164.678
Current President's Budget	174.447	158.745	125.557	-	125.557
Total Adjustments	-4.169	0.000	-39.121	-	-39.121
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.233	0.000			
• SBIR/STTR Transfer	-3.936	0.000			
• Program Adjustments	0.000	0.000	-39.121	-	-39.121

Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Navy					Date: May 2017
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 2: *Applied Research*			R-1 Program Element (Number/Name) PE 0602123N *I Force Protection Applied Res*		
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2016	FY 2017
Project: 9999: *Congressional Adds*		
Congressional Add: *Alternative Energy Research*	19.310	0.000
Congressional Add Subtotals for Project: 9999	19.310	0.000
Congressional Add Totals for all Projects	19.310	0.000

Change Summary Explanation

The funding decrease from FY 2017 to FY 2018 reflects the realignment of the Autonomous Aerial Cargo/Utility System project, the Joint Tern programs, and the Medium Displacement Unmanned Surface Vehicle (MDUSV) effort to the new innovative naval prototype program element 0602792N Innovate Naval Prototypes.

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy			Date: May 2017
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602123N / *Force Protection Applied Res*	Project (Number/Name) 0000 / *Force Protection Applied 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: *Force Protection Applied Res*	0.000	155.137	158.745	125.557	-	125.557	124.007	121.863	121.922	124.398	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. It supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial, and air) and the protection of those platforms. The goal is to provide the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage while preserving operational capability. Within the Naval Transformational Roadmap, this investment directly supports the Theater Air and Missile Defense transformational capability required by Sea Shield and the Ship to Objective Maneuver key transformational capability by virtue of improvements in platform offensive performance, stealth, and self-defense.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Title: AIRCRAFT TECHNOLOGY	68.638	65.452	39.461	0.000	39.461
Description: The Aircraft Technology activity develops technologies for reduced observables technology and enhanced capability of naval aviation aircraft platforms in terms of mission effectiveness, platform range, responsiveness, survivability, observability, readiness, safety and life cycle cost. It also develops new Naval air vehicle concepts and high impact, saleable naval air vehicle technologies, such as - autonomous air vehicle command and control, helicopter and tilt rotorsystems, aerodynamics, propulsion systems, materials, structures and flight controls for future and legacy air vehicles. Variable Cycle Advanced Technology (VCAT) will identify and mature critical, relevant variable/adaptive cycle propulsion system technologies for the next generation carrier-based Tactical Aircraft (TACAIR)/Intelligence, Surveillance and Reconnaissance (ISR) systems. Autonomous Aerial Cargo/Utility System (AACUS) will develop advanced autonomous capabilities to enable rapid resupply of distributed forces in the short term. The Sea-Based Aviation National Naval Responsibility (SBA NNR) Structures and Materials program will develop the next generation structural capability and material response science for aircraft technology in fixed and rotary wing, manned and unmanned airframe technology to achieve reduced weight, increased durability, strength, streamlined manufacturability, reduced life-cycle cost and maintenance/readiness gaps improvements. Program payoffs include increased availability/readiness, reduced sustainment requirements, fatigue/loads life enhancement, reduced weight and improved range, and advanced prognostics design tools.					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
These efforts addresses unique attributes to propulsion and power technologies for Naval Aviation, as well as those having higher importance to Naval Aviation and some that are more pervasive to all of military aviation. Related basic research efforts are addressed under 0601153N Defense Research Sciences. The funding decrease from FY 2016 to FY 2017 is due to maturation of AACUS technology applied research effort. The funding decrease from FY 2017 to FY 2018 is due to AACUS and joint Tern programs moving to new innovative naval prototypes PE 0602792N Innovative Naval Prototypes. ***FY 2016 Accomplishments:*** - Continued new efforts on high confidence/Safe Autonomous Control in naval environments and on supervisory control of decentralized heterogeneous UAS. - Continued SBA NNR related projects in Virtual Ship/Aircraft Dynamic Interface, Manned/Unmanned Handling Qualities and Control, Automated Deck Operations, High Lift Aerodynamics and Vertical/Short Takeoff and Landing (V/STOL) Operations. - Continued applied research efforts under the Sea-Based Aviation National Naval Responsibility Propulsion thrust area. - Continued development of rotorcraft/VTOL systems automated launch and recovery technology. - Continued mixed-mode mechanical/environmental failure prediction research. - Continued advanced composite durability technology. - Continued material degradation risk prediction and operational environment-driven materials selection methods. - Continued demonstration of initial core software, sensor, air vehicle, and capability applications for Autonomous Aerial Cargo/Utility System (AACUS). - Continued the advanced technology demonstration portion of the Variable Cycle Advanced Technology (VCAT) Program. Critical technology development efforts will begin with major engine manufactures and system contractors to develop/mature the highest priority, long-lead propulsion system technologies, including variable/ adaptive cycle engine components, for next generation carrier-based TACAIR/ISR systems. - Continued VCAT Phase I variable cycle engine/propulsion subsystem technology development efforts through completion. - Continued to explore and evaluate future aircraft concepts and their associated enabling technologies. - Continued development of survivability/reduced observables technology. Metrics are classified.					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continued new efforts on safe-perception based autonomous control in complex naval environments and on autonomy to support combined unmanned and manned air systems/units. - Continued airplane launch and recovery component and subsystem technology developments to enable medium size long endurance, long range UAVs to be launched and recovered on short deck ships. ***FY 2017 Plans:*** - Continue all efforts of FY 2016. ***FY 2018 Base Plans:*** - Pursue research related to Sea-Based Aviation (SBA) National Naval Responsibility (NNR) priorities in Aviation, Propulsion, and Structures and Materials. - Examples of research in Aircraft Technology include efforts in Virtual Ship/Aircraft Dynamic Interface, Manned/ Unmanned Handling Qualities and Control, Automated Deck Operations, High Lift Aerodynamics and Vertical/ Short Takeoff and Landing (V/STOL) Operations, the development of rotorcraft/VTOL systems automated launch and recovery technology and mechanical/environmental failure prediction research. - Examples of research in Propulsion include the Variable Cycle Advanced Technology (VCAT) Program. Major engine manufacturers and system contractors will develop/mature the highest priority, long-lead propulsion system technologies, including variable/adaptive cycle engine components, for next generation carrier-based TACAIR/ISR systems. - Examples of research in Structures and Materials include advanced composite durability technology. - Expanding material degradation risk prediction and operational environment-driven materials selection methods. Pursue research related to Autonomy including efforts on high confidence/Safe Autonomous Control in naval environments and on supervisory control of decentralized heterogeneous UAS. Expand efforts on safe-perception based autonomous control in complex naval environments and on autonomy to support combined unmanned and manned air systems/units. ***FY 2018 OCO Plans:*** N/A					
Title: FLEET FORCE PROTECTION AND DEFENSE AGAINST UNDERSEA THREATS	2.532	2.527	5.754	0.000	5.754
Description: Fleet Force Protection and Defense against Undersea Threats efforts include applied research for complementary sensor and processing technologies for platform protection. Current small platforms (both surface and airborne) have little to no situational awareness (SA) or self-protection against air, surface, and asymmetric threats. A goal of this activity is to provide these platforms with effective self-protection.					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
The technology areas specific to platform protection will develop individual, multispectral electro-optical (EO), infrared (IR), radio frequency (RF), electro-magnetic (EM), visual and acoustic or chemical sensors/ biosensors and associated processing. To defend platforms from current and advanced threats in at-sea littoral environments and in port, these technologies must improve multispectral detection and distribution of specific threat information. The funding increase from FY2017 to FY2018 is due to the increased investment and research efforts supporting distributed autonomous underwater networks. ***FY 2016 Accomplishments:*** Sensors & Associated Processing: - Continued Electrochemical sensors for the distributed, remote detection of explosives - Continued efforts in biomimetic sonar systems for operation in air and aquatic environments based on bat echolocation neurophysiology and information processing algorithms. - Continued efforts in biomimetic signal processing: panoramic periscope for submarines and temporal pattern recognition for Systems for Security Breaching Noise Detection. - Continued efforts in bioinspired quiet, efficient and maneuverable self-propelled line array using high-lift propulsors based on insect biomechanics. - Continued studies to develop catalytic activity profile of bioactive coatings against chemical agents. - Continued design and initiated fabrication of coatings to degrade both, chemical and biological agents. - Continued efforts to design microfabricated system for 3-color fluorescence measurements using integrated waveguides. - Continued effort to develop new, highly selective, preferential oxidation catalysts for the generation of power from the reformate gas purification process. - Continued effort to develop aspheric gradient index optics. - Continued effort to develop an implosion-resistant hydrogen storage technology for use in undersea fuel cells. - Continued development of wide area standoff detection of explosives. ***FY 2017 Plans:*** Sensors & Associated Processing: - Continue all efforts of FY 2016, unless noted as completed above. ***FY 2018 Base Plans:*** Sensors & Associated Processing:					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continue all efforts of FY 2017, unless noted as completed above. Undersea Warfare -Conduct undersea storage capacity of hydrogen by developing an implosion-resistant, safe, and inexpensive hydrogen storage technology that addresses powering autonomous systems, such as autonomous undersea vehicles and distributed autonomous underwater networks, for persistent force protection and defense against undersea threats. Materials and Chemistry -Design and develop, utilizing room temperature ionic liquids to demonstrate and fabricate inexpensive, miniaturized, low power electrochemical sensors for use in autonomous as well as distributed sensor networks. -Develop real time, standoff, moving target, laser based detection for explosives and hazardous chemicals with the intent of shifting the paradigm of trace chemical detection through surface contact swabbing to a faster, more flexible wide area, standoff method for significant enhancement of force protection. -Develop and design a new class of safe high performance rechargeable zinc air batteries to supplant state of lithium-ion batteries. -Develop chemical vapor sensing strategy for application in marine environment, significantly different than terrestrial environment. -Demonstrate electrochemical detection elements incorporated into electronic integrated circuits. -Demonstrate efficiency of zinc sponge anode in an electrochemical cell. ***FY 2018 OCO Plans:*** N/A					
Title: ADVANCED ENERGETICS ***Description:*** Advanced Energetics efforts address technology development to provide substantial improvements in energetic material systems and subsystems, primarily in terms of performance, but also addressing safety, reliability, and affordability concerns. Goals include: advanced energetic materials for warheads, propellants, and reactive material based subsystems for both defensive and offensive applications. Efforts include: development of new fuels, oxidizers, explosive ingredients and formulations; and reliable simulation tools and diagnostics to develop and design superior-performance, and/or reduced-vulnerability systems tailored to specific warfighter missions. ***FY 2016 Accomplishments:***	5.408	5.339	5.329	0.000	5.329

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continued process research and development of Ammonium Nitrotetrazolate-2N-oxide (AONT). - Continued the processing optimization design of material compositions for Reactive Material explosive fragment applications. - Continued optimization and refinement studies of Poly NitratoOxetane (3-PNO) process for solid rocket motor propellants. - Continued the development of a reliable chemical scale-up and material specification process techniques. - Continued ultra-high density reactive material investigations (13 - 15 grams/cc) for the next generation reactive material warhead material (formulations, material properties, target interaction, letality models, and experiments). - Continued Advanced Energetics research in development and evaluation of advanced explosive/propellant/ reactive ingredients and formulations for the next generation higher performing systems. - Continued non-traditional energy conversion studies with columbic and cluster material investigations. - Continued Advanced Energetics research in development of advanced directed hydro-reactive material warhead concepts to enhance performance of undersea warheads. - Continued proof of concept efforts to develop insensitive explosives, propellants, and munitions without compromising performance. This work involves development of high quality, small particle energetic ingredients, novel processing techniques, and advanced energy conversion concepts; and involves both theoretical and experimental efforts. - Continued Advanced Energetics research in advanced multiphase blast concepts employing dense metalized explosives to enhance performance of air and underwater blast warheads. - Continued Advanced Energetics research in development and diagnostics of novel energy conversion concepts to enhance performance, more efficiently exploit available energy, and more effectively couple energy to target for air, surface, and underwater warhead application - Continued research in technology development for the next generation reactive material warhead concepts formulations, material properties, and energy release experiments for highly reactive materials, high density reactive materials and novel reactive structural materials. Transition application specific target interaction, lethality modeling and ordnance specific experiments and demonstrations to Electromagnetic Rail Gun, PE 0603114N. - Continued development and evaluation of energetic ingredients and formulations for next generation higher performance applications. Concluded scale-up development and testing. - Continued the processing optimization design of material compositions for Reactive Material explosive fragment applications. - Continued the development of a reliable chemical scale-up and material specification process techniques. - Continued research on new caged nitramines					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continued process research and development of 1,1'-Diamino4,4',5'5'-Tetranitro-2,2'-Biimidiazole (DATNBI) - Continued process research and development of 1-Fluoro-4,5-Dinitroimidazole. ***FY 2017 Plans:*** - Continue all efforts of FY 2016, unless noted as complete above. - Initiate electric on/off propulsion system studies for advanced solid and liquid rocket compositions - Initiate process research and development of Dihydroxylammonium Dinitramino Azoxy Furazan (DDAF) - Initiate process research and development of Ammonium-3,4,5,-trinitropyrazolate (ATNPz) - Complete ultra-high density reactive material investigations (13 - 15 grams/cc) for the next generation reactive material warhead material (formulations, material properties, target interaction, lethality models, and experiments) - Complete process research and development of 1,1'-Diamino4,4',5'5'-Tetranitro-2,2'-Biimidiazole (DATNBI) - Complete process research and development of 1-Fluoro-4,5-Dinitroimidazole. ***FY 2018 Base Plans:*** - Pursue research related to Advanced Energetics including development and evaluation of advanced explosive/ propellant/reactive ingredients and formulations for the next generation higher performing systems. - Pursue research in proof of concept efforts to develop insensitive explosives, propellants, and munitions without compromising performance. This work involves development of high quality, small particle energetic ingredients, novel processing techniques, and advanced energy conversion concepts; and involves both theoretical and experimental efforts. - Expand Advanced Energetics research in development and diagnostics of novel energy conversion concepts to enhance performance, more efficiently exploit available energy, and more effectively couple energy to target for air, surface, and underwater warhead application. ***FY 2018 OCO Plans:*** N/A					
Title: SURFACE SHIP & SUBMARINE HULL MECHANICAL & ELECTRICAL (HM&E)	74.008	80.882	70.382	0.000	70.382
Description: Technology programs focused on providing technologically superior warfighting capabilities at reduced total ownership costs for surface and subsurface platforms through investments in applied research and advanced technology development of programs in: a) Advanced Naval Power b) hydrodynamics, c) structures d) autonomy for unmanned surface vehicles (USV) and e) platform survivability. This element also includes the National Naval Responsibility in Naval Engineering (NNR-NE). The NNR-NE supports early applied research in the areas of propulsion, platform structures, hydrodynamics, automation control and system engineering,					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
design tools, naval power systems and ensuring a strong and healthy academic infrastructure. Specific research themes are: Advanced Naval Power Systems Technology: Advanced naval power systems efforts address electrical and auxiliary system and component technology to dramatically improve energy and power density, operating efficiency and recoverability from casualties. A major investment focus is providing the power and energy required for directed energy weapons on current and future surface combatants. Advanced Naval Power efforts include: developing technologies for high-power, cyber-secured energy networks, providing warfighting capability with more energy efficient systems; mitigate adverse impacts of alternative fuel on Naval platforms and equipment; and utilizing the Electric Ship Research and Development Consortium (ESRDC) efforts to develop modeling and simulation tools to provide critical design & operational capabilities for the all-electric ship program, accelerate development and demonstration of technologies, reduce risk of new technology insertion and address the national shortage of electrical power engineers. Develop new machinery integration concepts. Develop simulation based Verification, Validation and Accreditation (VV&A) methods and technologies. Contribute to system reconfiguration. Design a ship electrical system architecture based on a main bus that distributes "rough" DC power throughout the ship at nominally 10 KV. Development of macro- and atomic-scale multi-physics models is being pursued to enhance understanding of materials processing & performance, energy conversion mechanisms, cyber-physical energy concepts, and power management. System-level studies focus on the scalability and reliability of component technologies. Another thrust is the development of tools to model heat transfer at multiple length scales allowing for simulation of heat flow through the ship in order to evaluate the impact of power conversion electronics, sensors, and weapons on the overall thermal balance of the vessel. Advanced Sea Platform Performance Technology: Hydrodynamics: Critical platform design for surface ships hydrodynamics that is focused on the theory, computation, and lab and at-sea experimentation to develop understanding and prediction capabilities for all hydrodynamic phenomena associated with surface ships and small craft, their effects on vessel performance, and concepts for modification. Propulsor hydrodynamics is focused on understanding the physics of flow around propulsors and their interactions to improve propulsor performance, mobility, efficiency, and affordability, as well as prediction and control of various types of cavitation on propulsors and appendages. This also includes predictive capability of cavitation inception, thrust breakdown, and erosion phenomenon and scaling					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
laws. Technology efforts in the area of Subsurface Hydrodynamics include identifying, understanding, predicting, and controlling flow physics, as well as turbulence and stratified wakes. This is further applied to Subsurface Maneuvering Technologies, and understanding the Dynamics of Interacting Platforms. Additionally hydrodynamic technologies focused on the signature aspects of the hull-propulsor interaction and maneuvering. Platform Structures: Focused on time-varying, structural reliability analysis and prediction for a ship structural system with uncertainty quantification and propagation. Specific topics include novel structural configurations across composite and metallic materials and prediction methods for advanced global hull strength, local panel and component strength, fatigue and fracture strength, and seaway loads and load effects for high-speed/high-performance ships and vessels. Hull life assurance addresses development of new structural system approaches for surface ships and submarines, including the management of weapons effects to control structural damage and the improvement of structural materials. Unmanned Surface Vehicles (USV): Autonomy for USVs and related mission functions aligned with Naval S&T strategic focus on autonomy and unmanned vehicles. Unmanned Sea Surface Vehicle applied research includes short-term motion forecasting for recovery of USSVs on a host ship in higher sea states and determination of slamming loads on high-speed planing hulls for structural weight reduction Distributed intelligence for automated survivability addresses both the basic technology of automating machinery control systems, as well as, distributed control of systems utilizing autonomy for mission context based reconfiguration. Sea Platform Survivability Technology: Aligned with survivability S&T strategic focus area, research investigates electromagnetic (EM) sources (including major ferro and non-ferromagnetic sources, eddy currents, and Corrosion Related Magnetic Fields (CRM)) that are associated with naval platforms. Develop understanding of EM field propagation relationships and analysis aids, and technologies to predict the electromagnetic properties of a naval platform. Advance physics based understanding of platform acoustics. Discover and develop algorithms and methods that will enable the development of improved design, analysis, and prediction tools for enhanced acoustic performance. Understand, design and develop optical and acoustic metamaterials to control light and sound propagation over a large frequency range. New architectures to overcome challenges associated with loss, bandwidth, and scalability are being explored. Design and develop models, algorithms, and integrated development environments for simulation and control of complex, interdependent, distributed shipboard machinery systems to enable integrated, autonomous operation and reconfiguration of shipboard machinery systems. Efforts also					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
include: signature reduction, hull life assurance, hydromechanics, distributed control for automated survivability (includes damage control), and advanced naval power systems. Signature reduction addresses electromagnetic, infrared, and acoustic signature tailoring, both topside and underwater. The funding increase from FY 2016 to FY 2017 is due to the ramping up of the Medium Displacement Unmanned Surface Vehicle (MDUSV) program and the Applied Research Challenge (ARC) effort. The funding decrease from FY 2017 to FY 2018 is due to the realignment of the Medium Displacement Unmanned Surface Vehicle (MDUSV) Leap Ahead effort to a new PE 0602792N Innovative Naval Prototypes (INP) Applied Research for consolidation of the Leap Ahead/INP portfolio. ***FY 2016 Accomplishments:*** Survivable Platforms - Reduced Signatures: - Continued advanced numerical acoustic codes (and gridding methods for those codes) for submarines. - Continued Alternating Current (AC) propagation experiments. - Continued the next generation Infrared Electro-Optic Visual (IR/EO/VIS) model for surface ships by development of mitigation strategy supporting low observable infrared platforms, development of supporting physics, and prototype measurement techniques. - Continued development of quiet control surface design tool based on control surface flow noise studies. - Continued IR and radar detectability prediction capability. - Continued surface ship super-conductive degaussing with laboratory demonstration loop for Electromagnetic (EM) field accuracy measurements and control methods. - Continued testing on Advanced Electric Ship Demonstrator (AESD) to assess energy propagation and acoustic radiation mechanisms and to develop mitigation concepts for surface ships. - Continued Improved Corrosion Related Magnetic (CRM) Field Prediction Model to design compensation systems to reduce ship's CRM signature. - Continued assessment of ship bi-static Radar Cross Section (RCS). - Continued large-scale tests on AESD to develop signature prediction and design tools for surface ship incorporating a variety of propulsion technologies including external podded propulsion. - Continued experimental effort to characterize electric drive motor signature mechanisms and verify modeling and simulation approaches for signature prediction.					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continued development of modeling methods and noise control concepts for modular/reconfigurable submarine architectures. - Continued investigation into hull treatment concepts for acoustic signature/vibration control for surface ships. - Continued development of signature modeling approaches for electric actuation and alternate electric drive system architectures. - Continued development of Low Probability Intercept (LPI) technologies for surface ship emissions including communication, navigation, electronic warfare, and combat systems. - Continued advanced EM modeling tools development and validation. - Continued modeling of hydroacoustics of turbulence-propulsor interaction. - Continued joint effort with UK/MoD on adhesively joined aluminum in lieu of welding of marine structures and thus reduce cost. - Continued joint effort with the Netherland Royal Navy (NLRN) on adhesive joined composite to metals in lieu of bolting of marine structures and thus reduce cost for topside structures. - Continued efforts on shock mitigation and shock diversion for ship hulls to reduce cost of machinery mounts and equipment, based on successful results from the Explosion Resistant Coatings (ERC) helmets for protection against Traumatic Brain Injury (TBI) - Continued utilization of condition-based maintenance systems for platform underwater signature assessment. - Continued development of signature monitoring and management capability of a surface ship propulsion system for underwater acoustic signatures. - Continued development of global optimization of damped structures. - Continued development of non-intrusive sensing method to measure component acoustic signatures. - Continued to develop improved processing techniques for acoustics experiments. - Continued development of a prediction and monitoring tool for underwater signatures. - Initiated planning at-sea experiments to determine principal offenders for small craft airborne and underwater acoustic signatures. - Initiated development of high fidelity airborne acoustic propagation and detection model for surfzone and littoral detection of small craft. - Initiated development of radar absorbing ballistic composite materials for small craft hull and superstructures. Survivable Platforms - Hull Life Assurance: - Continued efforts on combinations of highly rate-sensitive materials through experiment and modeling for extreme hyper velocity threat conditions. - Continued development of global surface wave measurement capability for ship models.					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continued Dynamic Behavior of Composite Ship Structures (DYCOSS) (joint effort with Dutch Navy). - Continued development of structural analysis codes describing failure mechanism of sandwich composites. - Continued Explosion Resistant Coatings (ERC) effort, providing US input to trilateral agreement with UK and Australia. - Continued composite and composite-metal hull performance characterization and testing including structural loading, thermal stress and signatures. - Continued effort on an advanced class of polymers as a follow-on to current ERC for application against advanced threats. - Continued Payload Implosion and Platform Damage Avoidance efforts. - Continued development of advanced analytical, numerical and experimental methods in support of platform signature reduction. - Continued effort on exploitation of polymers for the deflection and dissipation of shock wave impact on ship and submarine hull structures. - Continued development of lightweight low-cost protection system for specific platforms for protection against specific large threats. - Continued development of lightweight protection system for vehicles (MTVR) for protection against specific small arms and IEDs for the Explosion Resistant Coatings (ERC) program. - Continued Ship modifications using blisters for application to DDG51 Flight III to gain larger displacement for AMDR and at the same time achieve higher fuel efficiency. Survivable Platforms - Distributed Intelligence for Automated Survivability: - Continued development of modeling and simulation methods for robust design and virtual testing of integration of shipboard auxiliary systems including their control systems. - Continued research into advanced HM&E system reconfiguration approaches, including agent-based control systems and algorithms, and model-based reasoning. - Continued demonstration of Genetic Algorithm(s) for determining optimal distributed system control strategy. - Continued development of Survivability Analysis Algorithms Operable on a Total Ship Modeling Environment. - Continued the transition of the small scale hardware-in-the-loop demonstrator to the academic community for challenge problem formulation. - Continued demonstration of the developed model based reasoning control algorithms on full scale hardware test beds. - Continued development of underwater signature modeling.					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
Advanced Platforms - Advanced Platform Concepts and Designs: - Continued validation of asymmetric hull forms with experimental data. - Continued development of analytical models to further define submarine modular hull concepts. - Continued development of reliability based design and structural analysis code development. - Continued development of design tools for integrated antenna and composite topside. - Continued circulation control analysis for three-dimensional flow effects. - Continued aperstructures microwave communication system. - Continued concept for Ultra High Frequency (UHF)/Very High Frequency (VHF) aperstructures opportunistic array (Advanced Hull-form Inshore Demonstrator - AHFID). - Continued development of methods for determining reliability and vulnerability of aluminum ship structures. - Continued large scale demonstration efforts of advanced mitigation technologies. - Initiated activities in understanding platform modification for greater access in polar environments. Advanced Platforms - Hydromechanics: - Continued experimental database/computational tools development for extreme submarine maneuvers (e.g., crashback). - Continued the validation of circulation control and advanced control surfaces with experiments. - Continued to investigate improved maneuvering simulation capability for submarines. - Continued numerical prediction method(s) of waterjet cavitation. - Continued modeling and simulation of rough-wall boundary layer noise. - Continued development of podded propulsor design/analysis tools. - Continued prediction and validation of damaged stability and capsize. - Continued non-body-of-revolution tool development for advanced submarine configurations. - Continued the multi-platform interaction analysis and tool development. - Continued modeling of performance of composite propellers in extreme maneuvers. - Continued cavitation erosion modeling on compliant surface. - Continued a research on design/analysis methods of ice-capable propellers. - Continued a research on the effect of propeller on bubbly flows. - Initiate efforts to model platform performance and stability as well as propulsor performance in ice environments. Advanced Naval Power Systems:					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continued demonstration of dynamic stability of an advanced intelligent, reconfigurable, solid-state-based, zonai-electrical-power system that reconfigures within 10 milliseconds. - Continued designing software for the system manager for the Universal Control Architecture (UCA). - Continued development of thermal management technology for shipboard power distribution. - Continued investigation of potential applications of silicon-carbide in future high voltage and high power applications. - Continued improvements in electrical component and device technology allowing a reduction in motor propulsion and motor controllers weight and volume. - Continued development of technologies to support dynamic reconfiguration of shipboard systems under conditions of stressing scenarios and/or system degradation. - Continued studies of alternative cooling systems for future shipboard radar systems. - Continued control surface actuator project focused on the technologies needed to define the design space for control surface actuators supporting submarines. - Continued development of automated HVAC system architectures for future Naval platforms. - Continued ship service fuel cell development. - Continued program to develop and demonstrate 3 - 50 kW class solid oxide fuel cell onboard mobile power generation capabilities having compatibility with future logistics fuels to enable rapid recharge of batteries and direct power for C4ISR equipment. - Continued analytical model and reduced scale component development of power conversion technologies for multi-function motor drives, bi-directional power conversion modules, and power management controllers focusing on closing technology gaps associated with Alternative Integrated Power System (IPS) Architectures. - Continued studies of advanced heating, ventilation, and air-conditioning architectures, including studies of alternative (nonvapor-compression) refrigeration systems and concepts for waste heat reuse, to enhance ship cooling and provide thermal energy storage. - Continued research into the development of fuel chemistries, materials, and energy conversion technologies for optimal performance in Naval power systems. - Continued development of robotic Hull BUG and coating technologies to reduce hull biofouling over current Navy operating conditions which will reduce drag and provide significant power/fuel/cost savings. - Continued development of fuel cell components needed to make robust, compact, lightweight fuel cell systems for use in unmanned vehicles. - Continued development of low cost, light weight, flexible solar cells.					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continued effort to make significant impact in high voltage power electronics technology to enable compact power converters, medium voltage distributed power architectures, new weapons and sensor systems for Navy and Marine applications. - Completed effort to integrate front- and back-side diamond with high current GaN power switches for advanced thermal management. - Completed SiC GTO thyristor designs and testing apparatus to increase the turn-on dI/dt and reliability of SiC GTOs for pulsed power. Surface Ship & Submarine HM&E Applied Research: - Continued efforts to implement the results from hybrid composite blisters /appendages and their effect on ship drag resistance and fuel saving performance, motion and stability in ship models to verify computations and adapt shapes of appendages. - Continued to increase emphasis of the Science Advisor engagement within the joint S&T community across DOD, which will focus on addressing the operational and strategic needs of the Fleet. - Continued applied research into short-term motion forecasting for recovery in higher sea states. - Continued applied research into determination of slamming loads on high-speed planing hulls for structural weight reduction. - Continued the ONR Applied Research Challenge (ARC) to stimulate new, high-risk applied research projects in areas not currently addressed by the current ONR core applied research programs. - Initiated Medium Displacement Unmanned Surface Vessel (MDUSV) program applied research supporting a highly autonomous control and payloads supporting mine warfare, anti-submarine warfare and electronic warfare. Advanced ASW Surveillance: - Continued development of Long Endurance UUV technologies. Counter Improvised Explosive Devices: - Continued efforts to expand counter-improvised explosive devices (C-IED) enhancement to support urgent operational needs. - Continued research to analyze and understand enemy threat organizations and networks (both cultural networks and IT networks) - Continued research in directed energy weapons with the goal of reducing size, weight, and power requirements for systems in the detection and neutralization of IEDs.					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continued research in the mitigation of CIED effects (blast, blunt trauma, ballistics) on personnel. - Continued research in Route Reconnaissance and Clearance methodologies to provide standoff detection, neutralization, and marking of buried and surface laid, on and off route, pressure plate, command wire and radio frequency initiated explosive obstacles using directed energy and mechanical means on autonomous or semi autonomous platforms Applied Research Challenge (ARC): - Continue all base program efforts initiated in FY 2015 including network information sciences, long-range high-resolution imaging, ocean surface scatter in RF propagation, wake measurement technologies, thermal management systems, high power control modules for ship application, decision support / uncertainty analysis for operational environments, and reactive composite materials. Signature reduction: - Continued study of graphene based magnetic tunnel junctions.					
FY 2017 Plans: Survivable Platforms - Reduced Signatures: - Continue all efforts of FY 2016, unless noted as completed above. - Complete large scale tests on AESD to develop signature prediction and design tools for surface ship incorporating a variety of propulsion technologies including external podded propulsion - Complete investigation into hull treatment concepts for acoustic signature/vibration control for surface ships. - Complete development of signature modeling approaches for electric actuation and alternate electric drive system architectures. - Complete utilization of condition-based maintenance systems for platform underwater signature assessment. - Complete development of non-intrusive sensing method to measure component acoustic signatures. Survivable Platforms - Hull Life Assurance: - Continue all efforts of FY 2016, unless noted as completed above. - Complete Explosion Resistant Coatings (ERC) effort, providing US input to trilateral agreement with UK and Australia - Complete composite and composite-metal hull performance characterization and testing including structural loading, thermal stress and signatures. - Initiate Explosion Resistant Coatings (ERC) effort with TTCP countries.					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Initiate development of testing methodologies to validate computational codes and constitutive models for glassy materials. Survivable Platforms - Distributed Intelligence for Automated Survivability: - Continue all efforts of FY 2016, unless noted as completed above. Advanced Platforms - Advanced Platform Concepts and Designs: - Continue all efforts of FY 2016, unless noted as completed above. - Initiate activities in understanding platform modification for greater access in polar environments. Advanced Platforms - Hydromechanics: - Continue all efforts of FY 2016, unless noted as completed above. - Initiate efforts to model platform performance and stability as well as propulsor performance in ice environments. Advanced Naval Power Systems: - Continue all efforts of FY 2016, unless noted as completed above. - Complete development of robotic Hull BUG and coating technologies to reduce hull biofouling over current Navy operating conditions which will reduce drag and provide significant power/fuel/cost savings. Surface Ship & Submarine HM&E Applied Research: - Continue all efforts of FY 2016, unless noted as completed above. Counter Improvised Explosive Devices: - Continue all efforts of FY 2016, unless noted as completed above. - Complete efforts to expand counter-improvised explosive devices (C-IED) enhancement to support urgent operational needs. - Complete research to analyze and understand enemy threat organizations and networks (both cultural networks and IT networks) - Initiate research and development of modular, reconfigurable, integrated multi-modal stand-off detection and neutralization of explosive hazard (IED & Mines) system. Applied Research Challenge (ARC):					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continue all base program efforts initiated in FY 2016 including network information sciences, long-range high-resolution imaging, ocean surface scatter in RF propagation, wake measurement technologies, thermal management systems, high power control modules for ship application, decision support/uncertainty analysis for operational environments, and reactive composite materials.					
FY 2018 Base Plans: Advanced Naval Power Systems Technology: Pursue research related to the Next Generation Integrated Power System (NGIPS) and Distribution/Control of Power Advanced Power Systems with a focus on power and energy requirements for directed energy weapons on current and future surface combatants. Conduct applied research related to critical S&T to investigate efforts related to Power & Energy Technology, including alternative power sources, UAV fuel cell development and power and energy outreach and sustainability efforts Advanced Sea Platform Performance Technology: Conduct applied research related to critical S&T to investigate platform design efforts related to propulsor and subsurface hydrodynamics; structural reliability science; and structural acoustics. (FGLI 2018-0358) Expand research related to the unmanned sea surface vehicle and Medium Displacement Unmanned Surface Vehicle (MDUSV) efforts. Pursue research related to naval engineering and platform design, including Ohio Replacement Program efforts. Sea Platform Survivability Technology: Conduct applied research related to critical S&T to investigate efforts related to signature reduction; machinery autonomy; and platform survivability. Science & Technology to Address Complex Hybrid WarfareThreats: - Continue all efforts of FY 2017, unless noted as completed above. - Complete research in the mitigation of C-IED effects (blast, blunt trauma, ballistics) on personnel. - Initiate projects to counter complex hybrid warfare threats. S&T technologies will address a broad range of multi-faceted threats that employ both conventional and unconventional forces. Applied Research Challenge (ARC):					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Continue all base program efforts initiated in FY 2017 including network information sciences, long-range high-resolution imaging, ocean surface scatter in RF propagation, wake measurement technologies, thermal management systems, high power control modules for ship application, decision support/uncertainty analysis for operational environments, and reactive composite materials. Materials and Chemistry (NRL) Understanding methods for fabricating nickel / graphene / cobalt magnetic tunneling junctions to develop new tunnel barrier materials technology for fast low power radiation hard memory and magnetic sensors. This effort will be a paradigm shift for magnetic tunnel junction technology, which is significantly different than use of conventional oxides such as MgO and Al2O3. Successful accomplishments have been made to show that graphene can be used as a tunnel barrier material. Electronics (NRL) Create and explore new high voltage, high efficiency wide bandgap and ultra-wide bandgap power switches for electric propulsion and electric weapons. ***FY 2018 OCO Plans:*** N/A					
Title: NAVAL RESEARCH ENTERPRISE ***Description:*** The Independent Applied Research (IAR) R2 activity was stood up in FY 2013 as the Naval Research Enterprise (NRE) to consolidate all NRE related IAR investments. Projects funded in this R2 Activity are intended to be approximately 2-3 years in length. Based on historical trends approximately 30% of these projects will turn over each year. The Naval Research Enterprise (NRE) encompasses the IAR efforts focused on solving a wide range of Naval Science and Technology (S&T) fleet issues utilizing unique Naval Warfare Center (WC) laboratory capabilities. Efforts under this activity address the full spectrum of the DON S&T Strategic Plan technology using focus areas which engage Naval aviation, sea surface, undersea, space, weapons, communication, information, and human systems. The IAR Program provides participating WCs with in-house funding for applied research to support the execution of their assigned missions by: -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 the hiring and development of talented new scientists and engineers (S&E) with the insurance of proper mentoring with senior personnel.	4.551	4.545	4.631	0.000	4.631

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
-Encouraging collaboration with universities, private industry, and other Navy and Department of Defense laboratories. Funded projects are chosen through rigorous internal competition by each WC's selection committee and typically last two to three years. IAR projects are generally designed to promote investment in high-risk/high-payoff research and also allow young S&Es to manage Navy relevant research projects. A limited number of successful efforts developed under the In-House Laboratory Independent Research (ILIR) basic research Program Element 0601152N are matured and further developed under the IAR program with the goal of transitioning these technologies to the warfighter. ***FY 2016 Accomplishments:*** - Continued research for the repair and repair process of Navy aircraft and ship alloys such as titanium and high-strength low-alloy steels, composites, and metamaterials. - Continued research for highly accurate autonomous unmanned undersea vehicles (UUV) communication and navigation. - Complete all two year efforts started in FY 2015 and three year efforts started in FY 2014. Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE: - Completed research on Bio-inspired Broadband Sonar System for High-resolution Acoustic Imaging Applications. - Completed research on Advanced Infrared Suppressor. - Completed Determining R-45M Prepolymer Characteristics that Optimize Propellant Cure and Mechanical Properties. - Completed Development of Novel Propellants and Explosives Using Resonant Acoustic Mixing (RAM) Technology. - Completed study of the Electromagnetic Probability-of-effect Assessment Tool (EMPAT) for High-Power HERO/EMV Test and Evaluation . - Completed Examination of Human Performance Characteristics using Eye-tracking and 3D Motion Capture Gaze Supported Gestures. - Completed research on Extended Object Tracking in Clutter with Exploitation of Doppler Measurements and Multi-Scan Detection Clustering. - Completed Research on Geospatial and Temporal Anomaly Detection using Scalable Cloud-Based Algorithms - Completed Improving Damage Tolerance Thresholds and Energy Absorption Capacities in Laminated Woven Composites using Crimp Imbalance and Crimp Imbalance Gradients					

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 0000 / *Force Protection Applied Res*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total
- Completed Nondestructive Evaluation (NDE) Enhanced Accelerated Life Testing (ALT). - Completed Synthesis and Characterization of Novel Reactive Materials by Mechanical Alloying. - Completed Smoothed Particle Applied Mechanics research. - Initiated FY 2016 projects. ***FY 2017 Plans:*** - Complete FY 2015 IAR projects which were three years in duration. - Continue IAR projects initiated in FY 2016. - Initiate FY 2017 IAR projects that are intended to be approximately three years in length. ***FY 2018 Base Plans:*** - Complete FY 2016 IAR projects which were three years in duration. - Continue IAR projects initiated in FY 2017. - Initiate FY 2018 IAR projects that are intended to be approximately three years in length. ***FY 2018 OCO Plans:*** N/A					
Accomplishments/Planned Programs Subtotals	155.137	158.745	125.557	0.000	125.557

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

This PE supports the development of technologies associated with all naval platforms (surface, subsurface, terrestrial and air) and the protection of those platforms. Each PE Activity has unique goals and metrics, some of which include classified quantitative measurements. Overall metric goals are focused on achieving sufficient improvement in component or system capability such that the 6.2 applied research projects meet the need of or produce a demand for inclusion in advanced technology that may lead to incorporation into acquisition programs or industry products available to acquisition programs. Efforts funded in this PE also include energy programs in support of SECNAV energy goals and efforts in support of the Ohio Replacement program.

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy			Date: May 2017
Appropriation/Budget Activity 1319 / 2	R-1 Program Element (Number/Name) PE 0602123N / *Force Protection Applied Res*	Project (Number/Name) 9999 / *Congressional Adds*	

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
9999: *Congressional Adds*	0.000	19.310	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	19.310

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017
Congressional Add: Alternative Energy Research	19.310	0.000
FY 2016 Accomplishments: - Continue microgrid analyses at Naval Facilities in Hawaii to increase energy security for critical infrastructure and to determine capabilities needed for effective base-to-utility interconnect under conditions of high-penetration of renewables. - Continue heat exchanger material corrosion evaluation and process control evaluations for Ocean Thermal Energy Conversion (OTEC) systems. - Continue development of sophisticated hydrodynamic tools for design of high performance, high efficiency hull forms for naval ships and craft. - Continue support for wave energy system environmental characterization and modeling. - Continue hydrogen fuel cells research for operations in harsh environments including unmanned vehicles. - Continue support for energy storage technologies to mitigate the impact of renewables on grid stability. - Complete evaluation of grid frequency control techniques using grid frequency response and battery state-of-charge algorithms for lithium-titanate battery system, demonstrating 40% reduction in frequency variability on grid with high-penetration of wind power, and initiated similar battery approaches at grid locations with high-penetration of photovoltaics.		
FY 2017 Plans: N/A		
Congressional Adds Subtotals	19.310	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.

Exhibit R-2A, RDT&E Project Justification: FY 2018 Navy		Date: May 2017
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 9999 / *Congressional Adds*

E. Performance Metrics

Congressional Interest Items not included in other Projects.