Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy	Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	203.609	222.388	133.426	-	133.426	135.956	138.126	140.749	143.424	Continuing	Continuing
0000: *Force Protection Applied Res*	0.000	119.140	122.888	133.426	-	133.426	135.956	138.126	140.749	143.424	Continuing	Continuing
9999: *Congressional Adds*	0.000	84.469	99.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	183.969

A. Mission Description and Budget Item Justification

America is a maritime nation with global responsibilities that require U.S. naval forces be respected around the world and decisive when it matters. The Office of Naval Research (ONR) was established to guide ongoing research to ensure the technical superiority of the U.S. Navy and Marine Corps. This Program Element (PE) addresses applied research associated with providing the capability of Platform and Force Protection for the U.S. Navy. This program 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 deter, or avoid engagements, and if necessary, fight and win against adversary naval platforms or weapons. In the event of conflict, naval platforms must be able to resist and control damage while preserving operational capability. Research is focused on providing technologically superior defense of naval assets and delivering warfighting capabilities at reduced total ownership costs for surface and subsurface platforms through investments in applied research in: a) Power, Energy & Propulsion and b) Platform Design and Engineering. This program 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. The program addresses 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. The program supports mission-driven problem solving within the Naval Research and Development Establishment (NR&DE) through agile and rapid prototyping processes, while also promoting implementation of a common, effective innovation process and language.

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.

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B. Program Change Summary ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	209.008	122.888	0.000	-	0.000
Current President's Budget	203.609	222.388	133.426	-	133.426
Total Adjustments	-5.399	99.500	133.426	-	133.426
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	99.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	0.435	0.000			
• SBIR/STTR Transfer	-5.835	0.000			
• Rate/Misc Adjustments	0.001	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	133.426	-	133.426

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Project: 9999: *Congressional Adds*		
Congressional Add: *Power Generation and Storage Research*	4.827	0.000
Congressional Add: *Advanced Energetics Research*	4.827	3.000
Congressional Add: *Talent and technology for Navy power and energy systems*	10.136	10.500
Congressional Add: *Energy resilience efforts*	0.000	7.000
Congressional Add: *Coastal environmental research*	4.827	5.000
Congressional Add: *Data-Model Fusion*	2.896	0.000
Congressional Add: *Direct Air Capture and Blue Carbon Removal Technology*	7.240	10.000
Congressional Add: *Machine Discovery and Learning*	1.931	0.000
Congressional Add: *Additive Manufacturing of Unmanned Maritime Systems*	9.654	6.000
Congressional Add: *Asia Pacific Technology and Education Program*	4.827	0.000
Congressional Add: *Low Cost Silicon Solar Cells*	2.413	0.000
Congressional Add: *Navy Alternative Energy Research*	24.134	27.500
Congressional Add: *Robust Energy Infrastrucure Project*	6.757	0.000
Congressional Add: *relative position of autonomous platforms*	0.000	3.000
Congressional Add: *Bonded metal matric composit repair*	0.000	5.000

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Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Congressional Add: *Resilient innovative sustainable economies via university partnerships*	0.000	7.500
Congressional Add: *Titanium metal and wire domestic production demonstration*	0.000	15.000
Congressional Add Subtotals for Project: 9999	84.469	99.500
Congressional Add Totals for all Projects	84.469	99.500

Change Summary Explanation

Funding: The funding increase from FY 2022 to FY 2023 budget request is due to an increase for efforts associated with Naval Platform Operational Endurance & Climate Resiliency Technologies.

Technical: not applicable

Schedule: not applicable

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0000: *Force Protection Applied Res*	0.000	119.140	122.888	133.426	-	133.426	135.956	138.126	140.749	143.424	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. Research is focused on providing technologically superior defense of naval assets and delivering warfighting capabilities at reduced total ownership costs for surface and subsurface platforms through investments in applied research in: a) Power, Energy & Propulsion and b) Platform Design and Engineering. This project develops technologies for reduced observables technology and enhanced capability of naval platforms (surface, subsurface, terrestrial, and air) in terms of mission effectiveness, platform range, responsiveness, survivability, observability, readiness, safety and life cycle cost. The project addresses 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.

This project is broken out into five primary areas of study: Aircraft Technology, Fleet Force Protection and Defense Against Undersea Threats, Advanced Energetics, Surface Ship and Submarine Hull Mechanical & Electrical (HM&E), and Naval Research Enterprise.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Aircraft Technology	34.839	36.506	35.485	0.000	35.485
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, operational energy, expeditionary capability, 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 rotor systems, aerodynamics, propulsion systems, materials, structures and flight controls for future and legacy air vehicles. 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: PB 2023 Navy		Date: April 2022
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
These efforts address unique attributes to propulsion, power and thermal management 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. ***FY 2022 Plans:*** Research related to Sea Based Aviation National Naval Responsibility (SBA NNR) priorities in Aviation, Propulsion, and Structures and Materials. Research in Aircraft Science & Technology includes: Continuing efforts in the following: - Advanced analytical methods for achieving guaranteed performance in multibody control systems. - Control law synthesis methods to expand the recovery envelope and reduce touchdown loads. - Advanced modeling and analysis methods for ship/aircraft aerodynamic interface. - Air vehicle flying qualities and control. - High lift aerodynamics and control. - Vertical/Short Take-off and Landing (V/STOL) science & technology. - Automated launch and recovery technology. - Mechanical/environmental failure prediction research. Initiating efforts in the following: - Advanced dynamics and topology of coupled human/machine systems. - Precise relative navigation science & technology. - Integrated development environment for cyber secure avionics. - Infrastructure for rapid development, analysis, and experimentation with advanced flight science and technology across academia, government and industry. - Manned/unmanned teaming technology. Basic and applied research in Flight Dynamics & Control will develop theory, analysis and experimental data to better understand and exploit the natural dynamics of both conventional and unconventional air vehicles operating in the marine environment. Focus areas in Flight Dynamics & Control include continuing efforts in the following: - Multibody control systems and the ability to demonstrate guaranteed performance relative to a desired end state.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Robust and precise control in the presence of highly turbulent flow fields to increase operational capability and reduce structural requirements for ship-based operations; - Algorithms and sensors to enable precise ship-relative navigation in GPS-denied environments; - Control effectors and vehicle configurations to enable platforms with VTOL utility and fixed-wing efficiency. - Collaborative research to improve our knowledge of control system interactions between piloted aircraft and human performance. Applied Aerodynamics research for aircraft and weapons platforms will includes: Continuing efforts in the following: - Advanced computational methods addressing the Navy-unique challenge of a fully coupled aerodynamic interface between ships and aircraft; - Advanced methods for reduced-order modeling of complex flow fields to enable real-time, high-fidelity simulations of ship-based aircraft operations; - Advanced methods for manipulating and more precisely controlling the flow fields around air vehicles operating in the maritime environment. Expanding efforts in the following: - Novel diagnostics and techniques for in situ measurement ship airwake dynamics and its coupling to ship motions (sea states) and environmental flow field; Initiating efforts in the following: - Advanced technologies for improved weapons aerodynamics enabling increased range and maneuverability. - Innovative concepts for compact, highly-integrated inlets for air-breathing weapons. Applied research in aircraft Propulsion, Power and thermal management concepts for high speed, long endurance and responsiveness include: Continuing efforts in the following: - Cooling and thermal management for engines and auxiliary systems; - Diagnostics, prognostics and control for Integrated Power, Propulsion and Thermal Management; - Highly integrated Propulsion inlets, exhausts; - Sand, Salt and Dust Ingestion research: including modeling, separating, deposition, coatings and sensing; - Next Generation Propulsion Enablers includes applied research in propulsion, power and thermal management, advanced casing treatments, advanced compression system technologies and engine robustness in austere sand and salt environments. Expanding efforts in the following:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Highly loaded efficient Turbomachinery with improved operability; - Advanced materials and coatings for austere environments; Initiating efforts in the following: - Hybrid propulsion system component technologies for small to mid size VTOL capable UAS. Research related to Autonomy includes expanding the following efforts: - High confidence/Safe Autonomous single and multi-vehicle control in naval environments and human interaction with advanced autonomy such decentralized heterogeneous naval systems and interactive machine learning. - New theory-based methods and processes for rapid and safe adoption of new autonomy capabilities including Verification and Validation, safety, risk management, human systems integration, and robustness within complex naval, adversarial environments. - Safe perception based autonomous control in complex naval environments with limited communications and on autonomy to support combined unmanned and manned air systems/units. Structures and Materials Research includes: Continuing the following efforts: - Composites Characterization: development of composites characterization and validation methods for current and next generation composites for rapid certification and sustainment. - Galvanic compatibility tool development for assessing galvanic capability of metals in operational environment - Structural remediation: development of materials and processes for extending and restoring operational life. Initiating efforts in the following: - Hybrid nano-Composites - extend basic research investments in aligned carbon nano-tubes to develop damage tolerant composite structures for composites airframes. - Lightweight flight and transparent armor - Develop flight and transparent armor with improved performance than those currently fielded. - Lightweight multifunctional structures - Lightweight airframes and weapons by integrating functions such as energy storage and antennas in the load bearing structure. ***FY 2023 Base Plans:*** Research related to Sea Based Aviation National Naval Responsibility (SBA NNR) priorities in Aviation, Aerodynamics, Flight Dynamics & Control, Propulsion, and Structures & Materials.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Research in Aircraft Science & Technology includes: Continuing Efforts - Advanced analytical methods for achieving guaranteed performance in multibody control systems. - Control law synthesis methods to expand the recovery envelope and reduce touchdown loads. - Advanced modeling and analysis methods for ship/aircraft aerodynamic interface. - Air vehicle flying qualities and control. - High lift aerodynamics and control. - Vertical/Short Take-off and Landing (V/STOL) science & technology. - Automated launch and recovery technology. - Mechanical/environmental failure prediction research. - Advanced dynamics and topology of coupled human/machine systems. - Precise relative navigation science & technology. - Integrated development environment for cyber secure avionics. - Infrastructure for rapid development, analysis, and experimentation with advanced flight science and technology across academia, government and industry. - Manned/unmanned teaming technology. Applied research in Flight Dynamics & Control will develop theory, analysis and experimental data to better understand and exploit the natural dynamics of both conventional and unconventional air vehicles operating in the marine environment. Efforts include: Continuing Efforts - Multibody control systems and the ability to demonstrate guaranteed performance relative to a desired end state. - Robust and precise control in the presence of highly turbulent flow fields to increase operational capability and reduce structural requirements for ship-based operations; - Algorithms and sensors to enable precise ship-relative navigation in GPS-denied environments; - Control effectors and vehicle configurations to enable platforms with VTOL utility and fixed-wing efficiency. - Collaborative research to improve our knowledge of control system interactions between piloted aircraft and human performance.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Applied Aerodynamics research for aircraft and weapons platforms will include: Continuing Efforts - Advanced computational methods addressing the Navy-unique challenge of a fully coupled aerodynamic interface between ships and aircraft; - Advanced methods for reduced-order modeling of complex flow fields to enable real-time, high-fidelity simulations of ship-based aircraft operations. - Advanced methods for manipulating and more precisely controlling the flow fields around air vehicles operating in the maritime environment. - Novel diagnostics and techniques for in situ measurement ship airwake dynamics and its coupling to ship motions (sea states) and environmental flow field. - Advanced technologies for improved weapons aerodynamics enabling increased range and maneuverability. - Innovative concepts for compact, highly-integrated inlets for air-breathing weapons. Initiating Efforts - Innovative concepts for launch and recovery of unmanned aerial systems. - Understanding aerodynamics of novel air vehicle configurations, including the effects of multi-rotor systems and operational environments. Applied research in aircraft Propulsion, Power and thermal management concepts for high speed, long endurance and responsiveness include: Continuing Efforts - Cooling and thermal management for engines and auxiliary systems. - Diagnostics, prognostics and control for Integrated Power, Propulsion and Thermal Management. - Highly integrated Propulsion inlets, exhausts. - Sand, Salt and Dust Ingestion research: including modeling, separating, deposition, coatings and sensing.; - Next Generation Propulsion Enablers includes applied research in propulsion, power and thermal management, advanced casing treatments, advanced compression system technologies and engine robustness in austere sand and salt environments. - Enabling the use of 'hot' fuels as a heat sink and provide additional energy. - Highly loaded efficient Turbomachinery with improved operability. - Advanced materials and coatings for austere environments.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Hybrid propulsion system component technologies for small to mid-size VTOL capable UAS. Research related to Autonomy includes the following efforts: Continuing Efforts - High confidence/Safe Autonomous single and multi-vehicle control in naval environments and human interaction with advanced autonomy such decentralized heterogeneous naval systems and interactive machine learning. - New theory-based methods and processes for rapid and safe adoption of new autonomy capabilities including Verification and Validation, safety, risk management, human systems integration, and robustness within complex naval, adversarial environments. - Safe perception based autonomous control in complex naval environments with limited communications and on autonomy to support combined unmanned and manned air systems/units. Structures and Materials Research includes: Continuing Efforts - Structural remediation: development of materials and processes for extending and restoring operational life. - Hybrid nano-Composites - extend basic research investments in aligned carbon nano-tubes to develop damage tolerant composite structures for composites airframes. - Lightweight flight and transparent armor - Transparent armor with improved performance than those currently fielded. - Lightweight multifunctional structures Completing Efforts - Composites Characterization: development of composites characterization and validation methods for current and next generation composites for rapid certification and sustainment. - Galvanic compatibility tool development for assessing galvanic capability of metals in operational environment. Initiating Efforts - Structural Power Research - Thermoplastic composites					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Out of Autoclave and Out of Oven Composites Manufacturing. - Automated Composites Manufacturing - AI/ML applications for reducing composites defects -High Fidelity/ Unitized/ Optimized Structures for Aircraft and Weapons. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** The funding decrease from FY 2022 to FY 2023 is due to completing efforts in Structures and Materials Research.					
Title: Fleet Force Protection and Defense Against Undersea Threats	8.747	7.767	9.280	0.000	9.280
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 (surface, subsurface 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. 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. ***FY 2022 Plans:*** Electromagnetic Warfare: - Complete research conducted by one project in this area that provided an increase in the performance of airborne imaging radars by developing a 3D imaging capability for maritime applications. Materials and Chemistry: - Continue designing and developing inexpensive, miniaturized, low power electrochemical sensors for use in autonomous and distributed sensor networks in order to provide stand-off detection of explosive hazards in expeditionary missions; developing real time, standoff, moving target, laser based detection for explosives and hazardous chemicals in marine environment; developing chemical vapor sensing strategy for application					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
in marine environment; and developing ultra-high strength sintered ceramics for significant improvements in personnel protection and platform survivability. - Initiate development of high bandwidth modularized airborne ground penetrating radar array and related components as well as integrated near-real-time ground tracking and detection algorithm. - Initiate research and development of modular compact sensors and automated algorithms to rapidly assess, analyze, and report damage to infrastructure for repair following an attack or natural disaster particularly damage to runways, roads, piers, utilities, and buildings. - Complete efforts focused on the use of metal oxide nanoparticle functionalization of graphene conductometric devices to detect sulfur compounds in vapor and liquid phase aviation. Undersea Warfare: - Continue developing acoustics technology and associated signal processing to detect and track small-unmanned aerial vehicles for force and infrastructure protection; developing a pressure tolerant, inexpensive hydrogen storage based on hydrogenated graphene to increase undersea storage capacity; and developing technologies for active control of acoustic scattering to increase stealth and survivability of unmanned undersea vehicles. - Initiate efforts on safe-perception based autonomous control in complex naval environments and on autonomy to support combined unmanned and manned systems/units.					
FY 2023 Base Plans: Materials and Chemistry: - Continue designing and developing inexpensive, miniaturized, low power electrochemical sensors for use in autonomous and distributed sensor networks in order to provide real-time, stand-off detection of explosive hazards in expeditionary missions; developing real time, standoff, moving target, laser based detection for explosives and hazardous chemicals in littoral environment; and developing chemical vapor sensing strategy for application in littoral environment. - Continue the development of high bandwidth modularized airborne ground penetrating radar array and related components as well as integrated near-real-time ground tracking and detection algorithm. - Continue research and development of modular compact sensors and automated algorithms to rapidly assess, analyze, and report damage to infrastructure for repair following an attack or natural disaster particularly damage to runways, roads, piers, utilities, and buildings. - Initiate work on a low-cost, high performance, broadband infrared optics solution utilizing new materials.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Undersea Warfare: - Continue developing acoustics technology and associated signal processing to detect and track small-unmanned aerial vehicles for force and infrastructure protection; developing a pressure tolerant, inexpensive hydrogen storage based on hydrogenated graphene to increase undersea storage capacity; and developing technologies for active control of acoustic scattering to increase stealth and survivability of unmanned undersea vehicles. - Continue efforts on safe-perception based autonomous control in complex naval environments and on autonomy to support combined unmanned and manned systems/units. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** The funding increase from FY 2022 to FY 2023 is due to an increased emphasis on Optical Materials & Components as well as Seabed Infrastructure & Protection. Increased emphasis will be used to develop lighter, stronger, cheaper optical materials and components with improved performance to address the Navy / Marine Corps needs for personnel protection and platform survivability and situational awareness.					
Title: Advanced Energetics	5.225	5.475	5.321	0.000	5.321
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 2022 Plans:*** - Continue applied research related to Advanced Energetic materials with a focus on higher tactical weapon performance including longer range, reduced time-to-target, and enhancing overall lethality in addition to efforts to develop insensitive explosives, propellants, and munitions without compromising performance. - Continue research focused on development and evaluation of advanced explosive, propellant, and reactive composite ingredients and energetic formulations, in addition to various dynamic diagnostic experimental and multi-scale theoretical efforts for development of next generation higher performing weapon systems.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Expand research focused on ingredient chemistry and chemical processing technologies. This work includes: (i) synthesis, scale up, and evaluation of new energetic (i.e. explosives, oxidizers, fuels) and other formulation-enabling ingredients (i.e. polymer binders, plasticizers), (ii) incorporation of molecular design and particle morphology technology into synthetic scale-up and process development, and (iii) exploration and adaptation of innovative mixing, formulation, and other novel manufacturing processes for agile progression of enhanced energetic formulations. New compliant commodity ingredients, and new scale-up and formulation processes will be transitioned to the industrial base as appropriate. - Expand research in development and application of experimental 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 and propulsion applications. This work includes dynamic experimentation in support of design, evaluation and progression of enhanced lethality warhead concepts with focus on smaller form-factor without sacrificing effect on target; and advanced solid rocket motor, air-breathing, gun and other novel tactical propulsion concepts for extended range and reduced time-to-target. - Expand research in development and application of modeling, simulation, and computation to predict dynamic response and effects of energetic processes such as ignition, combustion/deflagration, shock, fragmentation, and detonation in order to predict weapon performance, lethality, and lifecycle for air, surface, and underwater weapon applications. Specific focus areas include applied theory and model development for understanding complex lethality mechanisms and properly assessing target damage for emerging warhead concepts and materials (i.e. high-density reactive materials) in addition to modeling efforts that support progression and transition of advanced tactical propulsion (i.e. ram-jets, high performance solid rocket motor). ***FY 2023 Base Plans:*** Overall, continue applied advanced energetic materials research efforts focused on longer range, reduced time-to-target, enhanced lethality/target effects, and cost savings pertaining to kinetic weapons without sacrificing insensitive munitions requirements. Continuing Efforts: -Applied research focused on development, scale up, and evaluation of novel explosive, propellant, and reactive composite ingredients and energetic formulations, in addition to dynamic diagnostic experimental and multi-scale theoretical efforts for development of next generation higher performing weapon systems. - Expanding research focused on ingredient chemistry and chemical processing technologies. This work includes: synthesis, scale up, and evaluation of new energetic (i.e. explosives, oxidizers, fuels) and other formulation-enabling ingredients (i.e. polymer binders, plasticizers), and exploration and adaptation of innovative					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
mixing, formulation, and other novel manufacturing processes for agile progression of enhanced energetic formulations. - Expanding research in development and application of experimental 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 and propulsion applications. This work includes: explosive blast, reactive materials, and propulsion relevant combustion science, shock-wave/energetic formulation studies, advanced tactical propulsion concepts, and ingredient specific structure/property studies. - Expanding research in development and application of modeling, simulation, and computation to predict dynamic response and effects of energetic processes such as ignition, combustion/deflagration, shock, fragmentation, and detonation in order to predict weapon performance, lethality, and lifecycle for air, surface, and underwater weapon applications. Completing Efforts: - Discontinuing minor efforts in ingredient development, experimental diagnostics, and modeling that do not show promise. Initiating Efforts: - Research focused on new ingredients and processing technologies including incorporation of molecular design and particle morphology technology into synthetic scale-up and process development. New compliant commodity ingredients, and new scale-up and formulation processes will be transitioned to the industrial base as appropriate. - Novel dynamic experimentation in support of design, evaluation and progression of enhanced lethality warhead concepts with focus on smaller form-factor without sacrificing effect on target; and advanced solid rocket motor, air-breathing, gun and other novel tactical propulsion concepts for extended range and reduced time-to-target. - Applied theory and model development for understanding complex lethality mechanisms and properly assessing target damage for emerging warhead concepts and materials (i.e. high-density reactive materials) in addition to modeling efforts that support progression and transition of advanced tactical propulsion (i.e. ram-jets, high performance solid rocket motor, detonation engines). ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:***					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
There is no significant change from FY 2022 to FY 2023.					
Title: Surface Ship and Submarine Hull Mechanical and Electrical (HM&E)	65.900	68.499	74.149	0.000	74.149
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) Power, Energy & Propulsion and b) Platform Design and Engineering. This element also includes the National Naval Responsibility in Naval Engineering (NNR-NE). Specific research themes are: Power, Energy and Propulsion Technology: Efforts address electrical and auxiliary system and component technology to dramatically improve naval capabilities by providing energy and power resiliency through applied research into energy and power density, control, operating efficiency, operational endurance, recoverability from casualties, and design tools. A major investment focus is providing the power, energy, and thermal management required for directed energy weapons and advanced sensor systems on current and future surface combatants. Significant investments are also focused on improving the energy performance of unmanned systems for the next generation surface fleet, subsea and seabed warfare, and expeditionary forces wherein the limited availability of power and energy are critical. Platform Design and Engineering Technology: This research area seeks to further the applied physics and mathematics necessary to improve the hydrodynamics, platform structures, platform resiliency/survivability, autonomy, and enabling digital technologies needed to improve naval warfighting capabilities as they relate to platforms/capabilities for use in expeditionary, surface and subsurface warfare. - Hydrodynamics: Critical design for naval platform hydrodynamics that is focused on the applied sciences, computation, laboratory experiments, and at-sea experimentation to develop the understanding and prediction capabilities for all hydrodynamic phenomena associated with naval sea-going platforms including, surface ships, submarines, unmanned vessels and manned small craft. Key research goals are to fully understand the physics of hydrodynamics of wakes, ship dynamics/control, propulsors and their effects on vessel performance and associated energy dissipation into the environment to provide science-based metrics for the evaluation of new design concepts to improve efficiency, signatures, and overall capabilities. - Platform Structures: Focused on all timescales of varying reliability of naval structures. Key applied research is focused on the analysis and prediction for a ship structural system with uncertainty quantification and propagation based on real world usage.					

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Unmanned Vehicles (UxV): Autonomy for UxVs and related mission functions aligned with Naval S&T strategic focus on autonomy and unmanned vehicles in support of surface, submarine, subsea/seabed naval warfare. - Sea Platform Resiliency: Aligned with survivability S&T strategic focus area, research investigates susceptibility, survivability, and recoverability of all naval platforms. Work in susceptibility of naval platforms concentrates on signature reduction across the acoustic and non-acoustic spectrums. .Applied research on survivability seeks to improve the ability of naval platforms to survive under stressing combat conditions, before, during, and after being affected by adversarial actions from kinetic and/or non-kinetic effectors. Research in recoverability of naval platforms seeks to better understand the complex nature of modern damage control measures necessary to enable platforms to recover to capability states necessary to avoid mission kill. - Digital Engineering: Naval engineering and platform design efforts to increase the speed to field and capability resiliency in the engineering process across platform lifecycles through the enablement of virtual design/monitor/usage models to be better informed through improved modeling and data science. Concentration of effort is placed on digitally linking all aspects of a platform lifecycle from ideation to destruction with identifiable metrics of military utility enabling fuller solution trade-space exploration.					
FY 2022 Plans: Power, Energy and Propulsion Technology: - Expand advanced energy systems research, which is focused on the analysis and optimization of resilient electrical grids and microgrids in the Pacific and across DON critical mission areas. Results from previous research will be used to evaluate and increase the energy resiliency of critically infrastructures on DON installations. Efforts include enhancing collaborations across academia, industry and DON beneficiaries. - Expand new and existing surface ship and submarine program efforts aimed at supporting electrical system reliability, as well as advanced power distribution and control to support both new and existing surface ship and submarine programs. This will be utilizing the Electric Ship Research and Development Consortium (ESRDC) to develop modeling and simulation tools, system analysis tools and models to provide critical design and operational capabilities for the all-electric ship program, accelerate development and demonstration of technologies, and to reduce risk of technology insertion. These efforts also address the national shortage of naval electrical power engineers. - Continue Next Generation Integrated Power System (NGIPS) and Distribution/Control of Power Advanced Power Systems efforts focused on power and energy requirements for directed energy weapons and advance					

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
sensor systems on current and future surface combatants, as well as for unmanned naval platforms, including thermal modeling. - Initiate research efforts associated with High Temperature Superconducting Cables for flexible ship degaussing system design and sustainable deployment for new and existing surface ship and submarine programs. Platform Design and Engineering Technology: - Continue applied research related to critical S&T that supports platform design and advanced capability efforts related to propulsor, surface, and subsurface hydrodynamics; platform performance, and platform structural reliability. Specific efforts include the following: utilize advanced analytics (machine learning and artificial intelligence), incorporate environmental effects on platform performance, research related to advancing unmanned sea surface vessel technologies and capabilities; naval engineering and platform design efforts to support set-based design for the Next Generation Attack Submarine SSN(X), and efforts to mitigate technology and susceptibility risk for the COLUMBIA class submarine program and the Future Surface Combatant Force. - Continue applied research related to critical S&T to investigate efforts related to signature reduction; structural and machinery acoustics; machinery autonomy; and platform survivability (detectability and susceptibility); and acoustic and non-acoustic signatures. Specific efforts include the following: utilize advanced analytics (machine learning and artificial intelligence), integrate environmental effects on platform performance and detectability, naval engineering and platform design to support the Next Generation Attack Submarine SSN(X), and mitigating technology and susceptibility risk for the COLUMBIA class submarine program and the Future Surface Combatant Force. - Continue/expand research efforts focused on the science and physics based signal detection technologies that, individually or as a system, can impact the security of the SSBN and submarines in general. Efforts looking at both passive and active detection technologies with near term (0-5 years), mid-term (5-10 years) and far term (10-20 years) implications, as well as improving the understanding of the generation, radiation, propagation, scatter, and detection of a variety of signal types (acoustic, chemical, optical, electromagnetic, hydrodynamic and radiological) associated with a submarine's operation. - Continue research related to critical multidisciplinary autonomy challenges that cut across areas/domains, including air, sea, undersea and ground. This includes multi-disciplinary research into the science of autonomy					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
focuses on four interrelated areas: scalable and robust distributed collaboration among autonomous systems; human/unmanned system collaboration; autonomous perception and intelligent decision-making; and intelligent architectures for autonomous systems. - Continue research to develop and test autonomy for Unmanned Undersea Vehicle (UUV) missions including understanding of counter-UUV autonomy options; implementations and testing; autonomy development involving a shared world model and sensor feedback; and extensive in-water testing. Spectrum Superiority: - Continue research efforts for passive and active long-range high-resolution detection and imaging for increased survivability and situational awareness even in degraded/contested environments. - Continue/expand research efforts to demonstrate portable sensor technology and machine learning based algorithms capable of identifying and recognizing emitters based off of unique RF characteristics in a complex EM environment. - Initiate research efforts exploring simultaneous full-spectrum (RF and optical) effects to enable full operations and signature control across the entire electromagnetic spectrum. Electronics: - Continue research to develop and explore new high voltage, high efficiency wide bandgap and ultra-wide bandgap power switches for electric propulsion and electric weapons. Current plans are to focus efforts on: Pioneering Vertical GaN High Power Switches; and Ultra-Wide Bandgap Gallium Oxide Power Device Transformative Integrated GaN Power Technology Platform. Materials and Chemistry: - Complete efforts associated with the design and demonstration of a rechargeable Zn-air battery with pulse-power capability that incorporates a Zn sponge anode and trifunctional air cathodes. Undersea Warfare:					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Continue research to reduce the time and cost for Submarine hull inspections by creating technologies for non-destructive evaluation (NDE) of submerged elastic surfaces coated with highly absorptive layers.					
FY 2023 Base Plans: Power, Energy and Propulsion Technology: - Continue research efforts associated with High Temperature Superconducting Cables for flexible ship degaussing system design and sustainable deployment for new and existing surface ship and submarine programs. - Complete advanced energy systems research, which is focused on the analysis and optimization of resilient electrical grids and microgrids in the Pacific and across DON critical mission areas. Results from previous research will be used to evaluate and increase the energy resiliency of critically infrastructures on DON installations. Efforts include enhancing collaborations across academia, industry and DON beneficiaries. - Complete research associated with Advanced Power Systems, Combat Power Systems and Energy Resiliency to expand surface ship and submarine program efforts aimed at supporting electrical system reliability, as well as advanced power distribution and control to support both new and existing surface ship and submarine programs. This will be utilizing the Electric Ship Research and Development Consortium (ESRDC) to develop modeling and simulation tools, system analysis tools and models to provide critical design and operational capabilities for the all-electric ship program, accelerate development and demonstration of technologies, and to reduce risk of technology insertion. These efforts also address the national shortage of naval electrical power engineers. - Complete HM&E initiatives associated with Next Generation Integrated Power System (NGIPS) and Distribution/Control of Power Advanced Power Systems efforts focused on power and energy requirements for directed energy weapons and advance sensor systems on current and future surface combatants, as well as for unmanned naval platforms, including thermal modeling. - Initiate and focus prior research efforts on the Naval Enterprise Partnership Teaming with Universities for National Entrepreneurship (NEPTUNE) program. The effort is derived from previous efforts in the areas of advanced energy systems research, which was focused on enhancing collaborations across academia, industry and DON beneficiaries. The NEPTUNE program is focused on conducting research that provides Navy Energy Education & Training for students. - Initiate applied superconductivity research in support of future Naval HM&E and mission systems. - Initiate applied research in Thermal Management. - Initiate applied research in Medium Voltage Direct Current (MVDC) electrical architectures.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Initiate research efforts in support of climate resiliency and clean energy to include applied research on low Global Warming Potential (GWP) refrigerants & environmentally friendly refrigeration cycles, electromechanical machinery applied research to reduce energy demand and improve component and power system energy conversion efficiencies, local generation of sustainable and zero-carbon fuels, DDG(X) advanced propulsion and to expand existing fuel efficiencies in the DDG-51 fleet, and design tools for uncrewed platform power architecture design, performance, and performance prediction Platform Design and Engineering Technology: - Complete research to develop and test autonomy for Unmanned Undersea Vehicle (UUV) missions including understanding of counter-UUV autonomy options; implementations and testing; autonomy development involving a shared world model and sensor feedback; and extensive in-water testing. - Complete applied research related to critical S&T that supports platform design and advanced capability efforts related to propulsor, surface, and subsurface hydrodynamics; platform performance, and platform structural reliability. - Complete applied research related to critical S&T to investigate efforts related to signature reduction; structural and machinery acoustics; machinery autonomy; and platform survivability (detectability and susceptibility); and acoustic and non-acoustic signatures. - Complete research efforts focused on the science and physics based signal detection technologies that, individually or as a system, can impact the security of the SSBN and submarines in general. - Complete research related to critical multidisciplinary autonomy challenges that cut across areas/domains, including air, sea, undersea and ground. This includes multi-disciplinary research into the science of autonomy focuses on four interrelated areas: scalable and robust distributed collaboration among autonomous systems; human/unmanned system collaboration; autonomous perception and intelligent decision-making; and intelligent architectures for autonomous systems. - Initiate and focus research efforts in the following areas: USV and UUV Applied Research, Vessel Dynamics with Propulsors, Submarine Wakes, Structural Reliability, EM Signature Reduction, Topside Signature Reduction, Machinery Autonomy, Platform Survivability, Structural Acoustic Signature Control, Top-Side Signature Development, Machine Learning, Digital Twins, Data Analytics Rapid Experimentation, and Submarine Security S&T-Susceptibility. These efforts are derived from previous efforts in the area of Platform Design and Engineering. - Initiate and focus research efforts focused on digital engineering, the digital framework, and the digital thread, particularly regarding design tools, in order to increase the reliability and resiliency across the lifecycle for					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
surface and undersea platforms, both manned and unmanned. These efforts are derived from previous efforts in the area of Platform Design and Engineering. - Initiate and focus research efforts on the Tactical Submarine Evolution Plan, Integrated Permanent Magnet Motors, Submarine Future Technologies and Future Surface Ship and Unmanned Technologies that support their capability evolution plans. These efforts are derived from previous efforts in the area of Platform Design and Engineering. Spectrum Superiority: - Continue research efforts for passive and active long-range high-resolution detection and imaging for increased survivability and situational awareness even in degraded/contested environments. - Continue research efforts to demonstrate portable sensor technology and machine learning based algorithms capable of identifying and recognizing emitters based off of unique RF characteristics in a complex EM environment. - Continue research efforts exploring simultaneous full-spectrum (RF and optical) effects to enable full operations and signature control across the entire electromagnetic spectrum and conduct laboratory-based sub-system demonstrations of component technologies. - Initiate research efforts into coherent combination of optical, infrared, and mm-wave imagers for increased resolution and longer-range detection. - Initiate development of microelectronics system on a transient glass substrate for controlled destruction, which will allow sensitive software application use in hostile operations. - Initiate development of machine learning techniques for automated signal identification in order for own-forces to understand and adjust electromagnetic spectrum signature. Electronics: - Continue research to develop and explore new high voltage, high efficiency wide bandgap and ultra-wide bandgap power switches for electric propulsion and electric weapons. Current plans are to focus efforts on: Pioneering Vertical GaN High Power Switches; Ultra-Wide Bandgap Gallium Oxide Power Device Transformative Integrated GaN Power Technology Platform; and High-Voltage Ultra-Fast SiC Semiconductor Closing Switches. Materials and Chemistry: - Initiate research into the use of prototype ammonium borosulfate electrolyte fuel cells to increase power output in current commercial solid acid fuel cells.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Undersea Warfare: - Complete research to reduce the time and cost for Submarine hull inspections by creating technologies for non-destructive evaluation (NDE) of submerged elastic surfaces coated with highly absorptive layers. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** The funding increase from FY 2022 to FY 2023 is due to an increase for efforts associated with Naval Platform Operational Endurance & Climate Resiliency Technologies.					
Title: Naval Research Enterprise	4.429	4.641	9.191	0.000	9.191
Description: The Naval Research Enterprise (NRE) supports mission-driven problem solving within the Naval Research and Development Establishment (NR&DE) through agile, rapid prototyping processes, while also promoting implementation of a common, effective innovation process and language. Adopting a common innovation process stimulates effective NR&DE-wide collaborations and facilitates NR&DE-wide sharing and implementation of best practices to accelerate the delivery of innovative capabilities to the warfighter. Activities are based on three foundational principles: (1) utilize innovative technical and business pathways that accelerate technology acquisition and deployment to the warfighter and pilot potential efforts as a result of this investigation; (2) leverage the commercial market and attract private investments to accelerate and reduce the cost for defense acquisition and deployment of technologies that provide capabilities to the warfighter; and (3) employ innovative best-practices in contracting that accelerate awards and provide flexibility and speed in technology and acquisition. The Independent Applied Research (IAR) Program focuses 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 Naval Research and Development Framework 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: (1) developing and maintaining a cadre of active researchers who can distill and extend results from worldwide research and apply them to solve Naval problems; (2) promoting the hiring and development of talented new scientists and engineers (S&E) with the insurance of proper mentoring with senior personnel; and (3) encouraging collaboration with universities, private industry, and other Navy and					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
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. ***FY 2022 Plans:*** - Continue development of innovative prototypes at Warfare Centers, Naval Laboratories, Naval Accelerator (NavalX) Tech Bridges and related DON organizations solving key warfighter problems that are identified through the Hacking for Defense (H4D) innovation process pipeline. - Continue/expand efforts that will be carried out under the Naval Innovations Process Adoption (NIPA) program to emphasize the implementation of a common process and language to promote collaborations and facilitate the use of best practices to accelerate the delivery of capabilities to the warfighter. - Initiate NIPA Challenges that solicit and expand the Department of the Navy (DON) industrial base, especially small businesses, to solve warfighter problems. The Challenges will employ the NavalX Tech Bridge network to reach the widest possible industrial base and to promote collaborations across the Naval R&D community. ***FY 2023 Base Plans:*** Naval Innovation Process Adoption (NIPA): - Continue/expand development of innovative prototypes at Warfare Centers, Naval Laboratories, NavalX Tech Bridges and related DON organizations solving key warfighter problems that are identified through the H4D innovation process pipeline. - Continue/expand efforts that will be carried out under the NIPA program to emphasize the implementation of a common process and language to promote collaborations and facilitate the use of best practices to accelerate the delivery of capabilities to the warfighter. - Continue NIPA Challenges that solicit and expand the DON industrial base, especially small businesses, to solve warfighter problems. The Challenges will employ the NavalX Tech Bridge network to reach the widest possible industrial base and to promote collaborations across the Naval R&D community. - Expand Naval sustainment efforts across Warfare Centers through cross-community NIPA/H4D Challenges and Small Business Innovative Research (SBIR) topics. - Support the Gordian Knot Center for National Security Innovation at Stanford University.					

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Independent Applied Research (IAR): Initiate the following efforts: - Naval warfare centers and laboratories generate new two- to three-year research topics where priority is given to warfighter needs, technology alignment, high quality research, and the recruitment and retention of outstanding scientists and engineers. Topics cover a broad range of naval relevant research areas critical to supporting the missions of the warfare centers and laboratories. - Utilize peer review process to select and evaluate IAR topics and develop a diverse S&T research portfolio. - Establish mid-year and annual progress review meetings to ensure topic objectives are being accomplished and projected outcomes are being achieved. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** The funding increase from FY 2022 to FY 2023 is due to funds being added for the Independent Applied Research (IAR) program.					
Accomplishments/Planned Programs Subtotals	119.140	122.888	133.426	0.000	133.426

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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COST ($ in Millions)	**Prior Years**	**FY 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
9999: *Congressional Adds*	0.000	84.469	99.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	183.969

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
Congressional Add: Power Generation and Storage Research ***FY 2021 Accomplishments:*** Conducted and expanded on-going competitively awarded efforts that improved Li-ion battery safety and increased micro-grid resiliency and efficiency ***FY 2022 Plans:*** N/A	4.827	0.000
Congressional Add: Advanced Energetics Research ***FY 2021 Accomplishments:*** Continued research towards the advanced demonstration of energetic materials in a variety of weapon system applications to include: high performance solid rocket and air breathing propulsion, reactive materials demonstrations and effects in advanced lethality and effectiveness models, advanced warhead concepts to include novel reactive shaped charge configurations, hybrid reactive material warhead demonstrations, and the development and demonstration of any necessary modeling and simulation capabilities for quantification of damage effects on adversary weapon systems, and other potential energetic technologies. ***FY 2022 Plans:*** Continue research towards the advanced demonstration of energetic materials in a variety of weapon system applications to include: high performance solid rocket and air breathing propulsion, reactive materials demonstrations and effects in advanced lethality and effectiveness models, advanced warhead concepts to include novel reactive shaped charge configurations, hybrid reactive material warhead demonstrations, and the development and demonstration of any necessary modeling and simulation capabilities for quantification of damage effects on adversary weapon systems, and other potential energetic technologies.	4.827	3.000
Congressional Add: Talent and technology for Navy power and energy systems	10.136	10.500

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
FY 2021 Accomplishments: Developed autonomous command and control of ship power and energy systems, leveraging digital twin technology that protects the ship's power and energy grid. In addition, designed and built a digital twin testbed for physical experimentation with power and energy controls technologies. ***FY 2022 Plans:*** Continue efforts to develop autonomous command and control of ship power and energy systems, leveraging digital twin technology that protects the ship's power and energy grid. In addition, designed and built a digital twin testbed for physical experimentation with power and energy controls technologies.		
Congressional Add: Energy resilience efforts ***FY 2021 Accomplishments:*** N/A ***FY 2022 Plans:*** Conduct applied research supporting energy resilience efforts	0.000	7.000
Congressional Add: Coastal environmental research ***FY 2021 Accomplishments:*** Provided a complete, portable, and field-tested ocean electro-magnetic observatory capable of global deployment to observe the fluid dynamics and magnetic signature of the ocean in coastal environments. Installed, calibrated, and collected data for the Navy's Electro-Magnetic Observatory prototype. ***FY 2022 Plans:*** Continue efforts to provided a complete, portable, and field-tested ocean electro-magnetic observatory capable of global deployment to observe the fluid dynamics and magnetic signature of the ocean in coastal environments. Installed, calibrated, and collected data for the Navy's Electro-Magnetic Observatory prototype.	4.827	5.000
Congressional Add: Data-Model Fusion ***FY 2021 Accomplishments:*** This project, "Data Model Fusion for Naval Engineering", under the Force Protection line, provided substantial science and technology work in the area of digital-twins, big data, and autonomy for the US Navy. Working under separate but parallel contracts, MDG and U of M propose to extend initial exploration of data-model fusion from FY20, focusing on methods to combine data-rich and data-sparse problems to provide robust system-level performance prognosis for autonomous platforms. They performed a series of fundamental research activities and table-top scale demonstrators at U of M, and real-world applications and demonstrations coordinated by MDG. ***FY 2022 Plans:*** N/A	2.896	0.000
Congressional Add: Direct Air Capture and Blue Carbon Removal Technology	7.240	10.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
FY 2021 Accomplishments: This funding supported direct air capture and blue carbon technology development. Advancements in these technologies and their integration with next generation fuel producing and material producing technologies will enhance DON & DoD fuel energy security. ***FY 2022 Plans:*** This funding will support direct air capture and blue carbon technology development. Advancements in these technologies and their integration with next generation fuel producing and material producing technologies will enhance DON & DoD fuel energy security.		
Congressional Add: Machine Discovery and Learning ***FY 2021 Accomplishments:*** Continued to develop emergent artificial intelligence (AI) and machine learning (ML) methods for discovery of energetic systems. Demonstrate use of these new methods to discover and transition defense-critical applications, in particular, significant improvements to undersea weapons of particular interest to the Naval Surface Warfare Center, Indian Head Explosive Ordnance Disposal Technology Division (NSWC IHEODTD), and the Navy, with the goal of significant and dramatic reductions in undersea weapon system size, cost and development time. The deliverable will be a methodology that can be used to discover new energetic materials and, ultimately, new energetics-based systems. ***FY 2022 Plans:*** N/A	1.931	0.000
Congressional Add: Additive Manufacturing of Unmanned Maritime Systems ***FY 2021 Accomplishments:*** This work developed advanced composite structures for an unmanned surface vessel (USV) using additive manufacturing techniques. The final USV enabled is expected to provide higher performance, lower weight, lower cost and faster manufacturing times than achievable with conventional technologies. This contract will deliver the USV design, hull manufacturing process demonstrations, full scale hull sections and a sub-scale complete hull. ***FY 2022 Plans:*** This work will develop advanced composite structures for an unmanned surface vessel (USV) using additive manufacturing techniques. The final USV enabled is expected to provide higher performance, lower weight, lower cost and faster manufacturing times than achievable with conventional technologies. This contract will deliver the USV design, hull manufacturing process demonstrations, full scale hull sections and a sub-scale complete hull.	9.654	6.000
Congressional Add: Asia Pacific Technology and Education Program	4.827	0.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
FY 2021 Accomplishments: Sponsor applied research supporting the Asia Pacific Technology and Education Program. ***FY 2022 Plans:*** N/A		
Congressional Add: Low Cost Silicon Solar Cells ***FY 2021 Accomplishments:*** Low Cost Silicon Solar Cells: North Dakota State University will work on new ways to chemically alter the cyclohexylsilane (CHS) ring, to yield facile processing routes to novel silicon devices (films, rods, quantum dots and associated devices such as thin film transitors and solar cells) and to enhance semiconductor properties with molecularly incorporated dopants. ***FY 2022 Plans:*** N/A	2.413	0.000
Congressional Add: Navy Alternative Energy Research ***FY 2021 Accomplishments:*** Conducted applied research supporting Navy Alternative Energy technologies. ***FY 2022 Plans:*** Conduct applied research supporting Navy Alternative Energy technologies.	24.134	27.500
Congressional Add: Robust Energy Infrastrucure Project ***FY 2021 Accomplishments:*** Conducted applied research in support of the Robust Energy Infrastructure Project. ***FY 2022 Plans:*** N/A	6.757	0.000
Congressional Add: relative position of autonomous platforms ***FY 2021 Accomplishments:*** N/A ***FY 2022 Plans:*** Conduct applied research in relative position of autonomous platforms	0.000	3.000
Congressional Add: Bonded metal matric composit repair ***FY 2021 Accomplishments:*** N/A ***FY 2022 Plans:*** Conduct applied research in bonded metal matric composite repair	0.000	5.000
Congressional Add: Resilient innovative sustainable economies via university partnerships	0.000	7.500

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
Appropriation/Budget Activity 1319 / 2	**R-1 Program Element (Number/Name)** PE 0602123N / *Force Protection Applied Res*	**Project (Number/Name)** 9999 / *Congressional Adds*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022
FY 2021 Accomplishments: N/A ***FY 2022 Plans:*** Conduct applied research for resilient innovative sustainable economies via university partnerships		
Congressional Add: Titanium metal and wire domestic production demonstration ***FY 2021 Accomplishments:*** N/A ***FY 2022 Plans:*** Conduct applied research supporting titanium metal and wire domestic production demonstration	0.000	15.000
Congressional Adds Subtotals	84.469	99.500

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

Not applicable.