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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Navy **Date:** May 2021

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603123N / <i>Force Protection Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	0.000	43.630	24.305	21.661	-	21.661	-	-	-	-	-	-
2912: <i>Force Protection Advanced Technology</i>	0.000	36.466	21.813	19.150	-	19.150	-	-	-	-	-	-
3049: <i>Force Protection</i>	0.000	2.337	2.492	2.511	-	2.511	-	-	-	-	-	-
9999: <i>Congressional Adds</i>	0.000	4.827	0.000	0.000	-	0.000	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This PE addresses advanced technology development associated with providing the capability of Platform and Force Protection for the U.S. Navy. This program supports the development of technologies associated with mission capable, persistent and survivable Naval platforms (surface, subsurface, terrestrial and air) in the areas of Platform Design & Engineering, Power, Energy & Propulsion, and Materials. The program develops technologies for 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, scalable Naval air vehicle technologies. The program also develops advanced technologies, critical to protecting naval installations, to provide seamless full spectrum protection against asymmetric attack by improving the ability to: detect and identify developing and immediate threats; shape our responses through improved situational awareness and decision making; shield personnel, mission critical facilities, infrastructure, and operating fleet assets; maintain essential functions; and sustain and restore critical services in the aftermath of an incident.

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 Advanced Technology Development (ATD) that includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment. Efforts in this PE generally have Technology Readiness Levels (TRL) of 4 (component and/or breadboard validation in laboratory environment.), 5 (component and/or breadboard validation in relevant environment.), or 6 (system/subsystem model or prototype demonstration in a relevant environment).

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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	40.286	24.410	21.723	-	21.723
Current President's Budget	43.630	24.305	21.661	-	21.661
Total Adjustments	3.344	-0.105	-0.062	-	-0.062
• Congressional General Reductions	-	-0.105			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	4.191	0.000			
• SBIR/STTR Transfer	-0.847	0.000			
• Rate/Misc Adjustments	0.000	0.000	-0.062	-	-0.062

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 9999: *Congressional Adds*

 Congressional Add: *Additive manufacturing for functional delays*

	FY 2020	FY 2021
	4.827	0.000
Congressional Add Subtotals for Project: 9999	4.827	0.000
Congressional Add Totals for all Projects	4.827	0.000

Change Summary Explanation

Funding: not applicable

Technical: not applicable

Schedule: not applicable

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy										Date: May 2021		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603123N / Force Protection Advanced Technology				Project (Number/Name) 2912 / Force Protection Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
2912: Force Protection Advanced Technology	0.000	36.466	21.813	19.150	-	19.150	-	-	-	-	-	-
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project addresses advanced technology development associated with providing the capability of Platform and Force Protection for the U.S. Navy. This project supports the development of technologies associated with mission capable, persistent and survivable Naval platforms (surface, subsurface, terrestrial, and air) in the areas of Platform Design & Engineering, Power, Energy & Propulsion, and Materials. This project develops technologies for 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, scalable Naval air vehicle technologies.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: Surface Ship and Submarine Hull Mechanical and Electrical (HM&E)	30.431	15.703	12.908	0.000	12.908
Articles:	-	-	-	-	-
Description: This project addresses advanced technology development associated with providing the capability of Platform and Force Protection for the U.S. Navy. This project supports the development of technologies associated with mission capable, persistent and survivable naval platforms (surface, subsurface and terrestrial) in the areas of Platform Design & Engineering, Power, Energy & Propulsion and Materials. The primary research efforts within this activity are focused on advanced technology development for Unmanned Sea Surface Vehicles in support of Naval S&T Focus Area on Autonomy and Unmanned Vehicles, At-Sea Vertical Launch System rearming and Advanced Materials Development. Unmanned Sea Surface Vehicle (USSV) technology development includes autonomous navigation for USSVs. Also funded in this activity is the Energy System Technology Evaluation Program (ESTEP), which promotes innovation and entrepreneurial opportunities for naval personnel and student veterans through advanced technology development and demonstration projects at naval facilities and laboratories.					
FY 2021 Plans:					
- Autonomous Unmanned Surface Vessel (USV): advance research related to the development of planing hull platforms. The technologies resulting from these efforts are being moved forward for use on unmanned surface vessels.					

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603123N / <i>Force Protection Advanced Technology</i>	Project (Number/Name) 2912 / <i>Force Protection Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
<p>- Energy Systems Technology Evaluation Program (E-STEP): project efforts focus on assessing advanced energy technologies, developing cyber-physical security for energy networks, and utilizing autonomous systems, artificial intelligence and advanced manufacturing to address operational challenges in logistics and readiness. Program goals include: advance dual-use and naval-unique technologies that increase operational capabilities and efficiencies; leverage commercial technologies and private investments to provide warfighter capability at reduced cost; and evaluate innovative technologies from naval laboratories and startup companies.</p> <p>- At-Sea Rearm of Vertical Launch System (ASRV): efforts will focus on further adapting and integrating seabasing technologies into a single system to demonstrate the ASRV capability in Sea State 4 in FY2022. This will include increasing the number of potential rearming sites and reduce off station time associated with rearming at known geographic locations.</p> <p>- Quality Metal Additive Manufacturing (Quality MADE): conduct research to do a final parts demonstration for accelerated qualification of materials and manufacturing processes for structural components. This effort is expected to complete in FY2022.</p> <p><i>FY 2022 Base Plans:</i></p> <p>- Continue Autonomous Unmanned Surface Vessel (USV): conduct advance research related to the development of planing hull platforms. The technologies resulting from these efforts are being further developed for use on unmanned surface vessels.</p> <p>- Continue At-Sea Rearm of Vertical Launch System (ASRV): completion task and efforts will focus on demonstrating the ASRV capability in Sea State 4.</p> <p>- Complete Energy Systems Technology Evaluation Program (E-STEP): project efforts focus on assessing advanced energy technologies, developing cyber-physical security for energy networks, and utilizing autonomous systems, artificial intelligence and advanced manufacturing to address operational challenges in logistics and readiness. Program goals include: advance dual-use and naval-unique technologies that increase operational capabilities and efficiencies; leverage commercial technologies and private investments to provide warfighter capability at reduced cost; and evaluate innovative technologies from naval laboratories and startup companies.</p>					

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Appropriation/Budget Activity 1319 / 3		R-1 Program Element (Number/Name) PE 0603123N / Force Protection Advanced Technology		Project (Number/Name) 2912 / Force Protection Advanced Technology	
B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)					
<p>- Complete Quality Metal Additive Manufacturing (Quality MADE): complete research and demonstration for accelerated qualification of materials and manufacturing processes for structural components.</p> <p>FY 2022 OCO Plans: N/A</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: The funding decrease from FY 2021 to FY 2022 is due to a ramping down of the Vertical Launch System (VLS) Reload at Sea effort and completion of the Energy Systems Technology Evaluation Program (E-STEP).</p>					
<p>Title: Aircraft Technology</p> <p align="right">Articles:</p> <p>Description: The Aircraft Technology activity develops technologies for 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, scalable Naval air vehicle technologies, such as helicopter and tiltrotor rotor drive systems, aerodynamics, propulsion systems, materials and structures for future and legacy air vehicles. This activity directly supports the Naval Research and Development Framework Priorities of Operational Endurance and Scalable Lethality.</p> <p>FY 2021 Plans:</p> <ul style="list-style-type: none"> - Further development of advanced technology for the Navy's (NGAD) carrier aircraft enabling technologies. NGAD, previously known as VCAT, Critical Technology development efforts will continue with major engine manufacturers to develop/mature the highest priority, long lead propulsion system turbine engine technologies, including: <ul style="list-style-type: none"> - variable/adaptive cycle engine controls and variable area turbines, - Ceramic Matrix Composites (CMC) and Polymer Matrix Composites (PMCs), - Integrated Propulsion, Power and Thermal Management Systems (IPPTMS) architectures, - advanced casing treatments, splitted rotors and slatted rotors, - advanced compression system technologies and compact combustors, - improved robustness in austere environment (sand, dust and salt ingestion). - These Critical Technology Elements will feed into the NGAD Tech Maturity and Risk Reduction (TMRR) Program and increase the aircraft's range, speed and endurance. <p>FY 2022 Base Plans:</p>					
	6.035	6.110	6.242	0.000	6.242
	-	-	-	-	-

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
<p>- Complete further development of advanced technology for the Navy's (NGAD) carrier aircraft enabling technologies. NGAD Critical Technology development efforts are focused on major engine manufacturers developing highest priority, long lead propulsion system turbine engine technologies.</p> <p>- Initiate technology development and maturation through Next Generation Propulsion - Enablers (NGP-E) with major engine manufacturers on the highest priority, long lead propulsion, power and thermal management technologies, including:</p> <ul style="list-style-type: none"> - Advanced, adaptive and modular controls. - Increased temperature capable Ceramic Matrix Composites (CMC) and Polymer Matrix Composites (PMC). - Advanced casing treatments and compression systems for increased operability and efficiency. - More compact combustion and augmentation systems. - More thermally efficient pumping systems. <p>FY 2022 OCO Plans: N/A</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: There is no significant change between FY 2021 and FY 2022.</p>					
Accomplishments/Planned Programs Subtotals	36.466	21.813	19.150	0.000	19.150

C. Other Program Funding Summary (\$ in Millions) N/A
Remarks
D. Acquisition Strategy N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy **Date:** May 2021

Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603123N / Force Protection Advanced Technology	Project (Number/Name) 3049 / Force Protection
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
3049: Force Protection	0.000	2.337	2.492	2.511	-	2.511	-	-	-	-	-	-
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Develop advanced technologies, critical to protecting naval installations, to provide seamless full spectrum protection against asymmetric attack by improving the ability to: detect and identify developing and immediate threats; shape our responses through improved situational awareness and decision making; shield personnel, mission critical facilities, infrastructure, and operating fleet assets; maintain essential functions; and sustain and restore critical services in the aftermath of an incident. Technologies developed will also seek to reduce the required manpower and skill levels devoted to the force protection mission, improving performance and reducing costs for the Navy.

B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: Emerging Threats	2.337	2.492	2.511	0.000	2.511
Articles:	-	-	-	-	-
<p>Description: Naval Installations are a critical component in support of Navy global force projection. These installations, and the Navy ships, submarines, and aircraft located on them, are under increasing risk from asymmetric attack, including from new threat vectors such as unmanned air, surface, and subsurface vehicles. This project is focused on the development advanced technologies necessary for the protection of Naval Installations. Technical efforts address the detect -to-engage-to-assess requirements for Naval Installations by improving the ability to: sense and identify threats; support improved situational awareness and decision making; and develop effective countermeasures. Technologies developed will also seek to reduce the required manpower and skill levels devoted to the force protection mission.</p> <p>FY 2021 Plans:</p> <ul style="list-style-type: none"> - (AMAPS): conduct a final demonstration, which will include unmanned response capabilities and a fully integrated Rocket Propelled Grenada (RPG) of the Sea (RPG-S) (C-UUV) capability. - Day/night all weather sensors: conduct an interim demonstration, which will include multi-static radar, Passive Millimeter Wave (PMMW) and Dual Band Infrared electro-optic sensors, to detect small unmanned air threats and surface threats in Degraded Visual environments (DVE). Demonstrate the capability for these DVE sensors to accurately cue counter measures systems and assess their effect in real time. 					

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)					
<p>- Automated Target Recognition algorithms: conduct an interim demonstration to assist operations center personnel in detecting and identifying threats.</p> <p>FY 2022 Base Plans:</p> <p>- Continue Autonomous Maritime Asset Protection System (AMAPS): conduct interim demonstration of autonomous assessment and response UAS capability to evaluate Unauthorized Access events on naval installation land and waterside perimeters.</p> <p>- Continue Day/night all weather sensors: conduct final demonstration of capability to detect, track, and identify small unmanned air threats using multi-static radar, Active Millimeter Wave (AMMW) and Dual Band Infrared electro-optic sensors. Optimize sensor performance and operator effectiveness using Automated Target Recognition algorithms.</p> <p>- Continue Automated Target Recognition algorithms: develop and demonstrate improved harbor security sonar capabilities to detect Unmanned Underwater Vehicles (UUVs) to include; increased volumetric coverage, passive detection and tracking algorithms, and new classification algorithms to address more capable threats.</p> <p>- Develop and demonstrate a kinetic response capability to interdict threat Unmanned Underwater Vehicles (UUV) detected in naval installation harbors.</p> <p>FY 2022 OCO Plans: N/A</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: There is no significant change between FY 2021 and FY 2022.</p>					
Accomplishments/Planned Programs Subtotals					
	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
	2.337	2.492	2.511	0.000	2.511
C. Other Program Funding Summary (\$ in Millions)					
N/A					
Remarks					
D. Acquisition Strategy					
N/A					

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Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603123N / <i>Force Protection Advanced Technology</i>	Project (Number/Name) 9999 / <i>Congressional Adds</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
9999: <i>Congressional Adds</i>	0.000	4.827	0.000	0.000	-	0.000	-	-	-	-	-	-
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2020	FY 2021
<i>Congressional Add:</i> Additive manufacturing for functional delays	4.827	0.000
<i>FY 2020 Accomplishments:</i> N/A		
<i>FY 2021 Plans:</i> N/A		
Congressional Adds Subtotals	4.827	0.000

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

N/A

Remarks

D. Acquisition Strategy

N/A