Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Navy												Date: March 2019
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603123N *I Force Protection Advanced Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	52.785	32.615	35.286	-	35.286	24.410	21.723	17.080	17.423	Continuing	Continuing
2912: *Force Protection Advanced Technology*	0.000	23.051	30.192	32.839	-	32.839	21.907	19.205	14.519	14.810	Continuing	Continuing
3049: *Force Protection*	0.000	2.695	2.423	2.447	-	2.447	2.503	2.518	2.561	2.613	Continuing	Continuing
9999: *Congressional Adds*	0.000	27.039	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	27.039

A. Mission Description and Budget Item Justification

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

This PE addresses 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 all naval platforms (surface, subsurface, terrestrial and air) and the protection of those platforms.

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

B. Program Change Summary ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**
Previous President's Budget	26.342	2.423	2.447	-	2.447
Current President's Budget	52.785	32.615	35.286	-	35.286
Total Adjustments	26.443	30.192	32.839	-	32.839
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	30.192			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.557	0.000			
• Program Adjustments	0.000	0.000	32.839	-	32.839
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Navy				Date: March 2019
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*		R-1 Program Element (Number/Name) PE 0603123N *I Force Protection Advanced Technology*		
• Congressional Add Adjustments	28.000	-	-	-

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

	FY 2018	FY 2019
Project: 9999: *Congressional Adds*		
Congressional Add: *Navy Automonous Swarmboats*	27.039	0.000
Congressional Add Subtotals for Project: 9999	27.039	0.000
Congressional Add Totals for all Projects	27.039	0.000

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
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 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
2912: *Force Protection Advanced Technology*	0.000	23.051	30.192	32.839	-	32.839	21.907	19.205	14.519	14.810	Continuing	Continuing

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 all naval platforms (surface, subsurface, terrestrial, and air) and the protection of those platforms. For the new FY 2016 effort, Forward Deployed Energy and Communications Outpost (FDECO) Innovative Naval Prototype (INP), the project addresses advanced technology development associated with providing the undersea energy and communications infrastructure necessary to assure undersea dominance; extend the reach of undersea assets; enhance situational awareness (SA) and standoff advantage without reducing forward presence and; provide endurance for unmanned systems necessary for force multiplication in an anti-access/area denial (A2/AD) environment. For the Medium Displacement Unmanned Surface Vehicle (MDUSV), the project will radically change the way the Navy does mine influence sweep, anti-submarine warfare (ASW) and electronic warfare (EW) missions; it will introduce larger unmanned surface vehicles (USV) to the Navy; and it will introduce advanced autonomy to the surface Navy.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: SURFACE SHIP & SUBMARINE HULL MECHANICAL & ELECTRICAL (HM&E)	17.161	23.941	26.703	0.000	26.703
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 various naval platforms (surface, subsurface and terrestrial) and the protection of those platforms. 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 and At-Sea Vertical Launch System rearming. 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. 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.					
FY 2019 Plans: Conduct advanced research related to critical S&T for development of autonomous navigation for Unmanned Sea Surface Vehicles from host ship. Expand research for conducting advanced technology demonstrations					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
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)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
to evaluate innovative energy technologies using Navy and Marine Corps facilities as test beds. Perform non-recurring engineering, modeling and fabrication necessary for a prototype and demonstration of At-Sea Rearm of Vertical Launch System (VLS) capability in a relevant environment during FY22. ***FY 2020 Base Plans:*** - Conduct advanced research related to critical S&T for development of autonomous navigation for Unmanned Sea Surface Vehicles from host ship. - Continue ESTEP project efforts, including assessment of advanced energy technologies; development of cyber-physical security for energy networks; and utilization of autonomous systems, artificial intelligence and advanced manufacturing to address operational challenges in logistics and readiness. - Continue efforts for prototype and operational FY22 demonstration of At-Sea Rearm of Vertical Launch System (ASRV) capability in a relevant environment including crane, mooring system, strike-up/strike-down system fabrication and testing. ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The funding increase from FY 2019 to FY 2020 includes additional investment to support preparation for prototype and operational FY 2022 demonstration of At-Sea Rearm of Vertical Launch System capability.					
Title: AIRCRAFT TECHNOLOGY	5.890	6.251	6.136	0.000	6.136
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 - autonomous air vehicle command and control, helicopter and tiltrotor rotor drive systems, aerodynamics, propulsion systems, materials, structures and flight controls for future and legacy air vehicles. This activity directly supports the Naval Research and Development Framework, principally in the Autonomy and Unmanned Systems, Platform Design and Survivability, Power and Energy and Total Ownership Cost Focus Areas. ***FY 2019 Plans:***					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
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)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Conduct advanced technology development efforts and demonstrations of the Variable Cycle Advanced Technology (VCAT) Program. Critical technology development efforts continue with major engine manufactures and system contractors to develop/mature the highest priority, long lead propulsion system technologies, including variable/adaptive cycle engine components, for next generation carrier based Tactical Air (TACAIR) Intelligence, Surveillance and Reconnaissance (ISR) systems. ***FY 2020 Base Plans:*** Conduct advanced technology development efforts and demonstrations of the Variable Cycle Advanced Technology (VCAT) Program which will enable the Navy's Next Generation Air Dominance (NGAD) carrier aircraft. Critical technology development efforts continue with major engine manufacturers and to develop/ mature the highest priority, long lead propulsion system technologies, including variable/adaptive cycle engine controls, variable area turbines, Ceramic Matrix Composites (CMC), Polymer Matrix Composites (PMC), and Integrated Propulsion, Power and Thermal Management Systems (IPPTMS) architectures and technologies. These efforts will support the Navy's planned NGAD Technology Maturation and Risk Reduction program for the engine design and development, and Integrated Propulsion, Power and Thermal Management System. ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** No significant change between FY 2019 and FY 2020					
Accomplishments/Planned Programs Subtotals	23.051	30.192	32.839	0.000	32.839

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

The overall goals of this advanced technology program are the development of technologies which focus on the warfighter and providing the ability to win or avoid engagements with other platforms or weapons and, in the event of engagement, to resist and control damage, while preserving operational capability. Overall metric goals are to transition the advanced technology projects into acquisition programs. Each Activity within this PE has unique goals and metrics, some of which include

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
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*

classified quantitative measurements. Specific examples of metrics under this PE include: - Advanced technology demonstrations to evaluate emerging energy technologies.

For the Forward Deployed Energy and Communications Outpost (FDECO) Innovative Naval Prototype (INP) effort, the overall goals is the development of technologies which focus on energy management and transfer technologies that enable persistent undersea operations by unmanned vehicle (UV) Fleet; provide system architectures that are persistent, scalable and mission agile; provide communication and energy infrastructure available in degraded and contested environments and; provide a platform-agnostic solution that reduces development and maintenance costs. Overall metric goals are to transition the key advanced technology elements, Forward Deployed Energy (FDE), Forward Deployed Communications (FDC) and Forward Deployed Docking (FDD) into acquisition programs. Each Activity within this PE has unique goals and metrics, some of which include classified quantitative measurements. Specific examples of metrics include: - Advanced technology demonstrations to evaluate energy and data transmission and persistent connectivity.

Medium Displacement Unmanned Surface Vehicle (MDUSV), the objectives are to 1) Demonstrate, using specific payloads, the multi-mission versatility of MDUSV, and identify key interface requirements for future payloads; 2) Provide a robust assessment of MDUSV's collision regulations (COLREGs) autonomy to build confidence in the reliability and safety of the autonomous control system; and 3) Enable the evaluation of MDUSV's operational utility and design to support an acquisition transition decision.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy											Date: March 2019	
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603123N / *Force Protection Advanced Technology*				Project (Number/Name) 3049 / *Force Protection*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
3049: *Force Protection*	0.000	2.695	2.423	2.447	-	2.447	2.503	2.518	2.561	2.613	Continuing	Continuing

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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: EMERGING THREATS	2.695	2.423	2.447	0.000	2.447
Description: This activity includes development of advanced technologies critical to protecting naval installations, and will provide seamless, full spectrum protection against asymmetric terrorist attack by improving the ability to: sense 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. ***FY 2019 Plans:*** Complete development and conduct full demonstration of Virtual Inductive Loop technology to include automated perimeter surveillance in the region of the entry control point. Replacing in ground inductive loops with video based virtual inductive loops will improve reliability and performance and reduce maintenance costs associated with Naval Facilities Engineering Command (NAVFAC) automated gates. Ongoing development of Autonomous Maritime Asset Protection capabilities for detection, classification, and defeat of small unmanned air, surface, and subsurface threats to naval installations through fusion of electro-optic sensors, acoustic sensors and countermeasures technologies demonstrated under this program. ***FY 2020 Base Plans:*** Continue development, and conduct interim demonstration, of the Autonomous Maritime Asset Protection System (AMAPS) capability including integration of unmanned response technologies. Develop capability to detect and counter small unmanned underwater vehicles (C-UUV) in the harbor environment and integrate into					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603123N / *Force Protection Advanced Technology*	**Project (Number/Name)** 3049 / *Force Protection*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
AMAPS. Develop technologies to detect and counter small unmanned air threats within the constraints and parameters associated with Commander Naval Installations (CNIC) and NAVFAC requirements. ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** There is no significant change from FY 2019 to FY 2020.					
Accomplishments/Planned Programs Subtotals	2.695	2.423	2.447	0.000	2.447

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

The overall goal of this program is to develop technologies which will provide protection for our naval installations against asymmetric attack. Specific metrics include: a 50% reduction of manpower required to perform force protection surveillance, situational awareness, and decision making, a 2x improvement in electro-optical sensor performance in adverse weather conditions, a 50% reduction in sensor cost per square or cubic meter of detection at a given resolution, and a 50% reduction in false alarm rates for automated detection and tracking algorithms both on, above and below water.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603123N / *Force Protection Advanced Technology*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	27.039	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	27.039

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019
Congressional Add: Navy Automonous Swarmboats	27.039	0.000
FY 2018 Accomplishments: Funding used to execute further research and support for Navy Autonomous Swarmboats, including multi-unmanned surface vehicle (USV) autonomous operations.		
FY 2019 Plans: N/A		
Congressional Adds Subtotals	27.039	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Congressional Interest Items not included in other Projects.