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 4: *Advanced Component Development & Prototypes (ACD&P)*					R-1 Program Element (Number/Name) PE 0603573N *I Advanced Surface Machinery Sys*							
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	221.748	22.406	27.109	25.408	-	25.408	42.825	31.709	24.465	24.292	Continuing	Continuing
2471: *Integrated Power Systems (IPS)*	221.748	22.406	22.109	25.408	-	25.408	42.825	31.709	24.465	24.292	Continuing	Continuing
9999: *Congressional Adds*	0.000	0.000	5.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.000

A. Mission Description and Budget Item Justification

The FY 2020 funding request was reduced by $2.086 million to account for the availability of prior year execution balances.

This Program Element (PE) includes the development of advanced surface ship Hull, Mechanical, and Electrical (HM&E) components and systems for all future ships and back-fit ships where appropriate as well as development of Cybersecurity protections for HM&E systems, previously referred to as Boundary Defense Capabilities, now called Situational Awareness, Boundary Enforcement & Response (SABER) for HM&E systems. This PE is managed by PMS 320, the Electric Ships Office, located organizationally within PEO SHIPS, responsible for developing Naval Power and Energy Systems that focus power system integration of Directed Energy (DE) and other high powered mission systems as well as platform integration and improving energy efficiency of those components and systems. The mission of PMS 320 is to develop and provide smaller, simpler, more affordable and more capable electric power systems for all Navy platforms, focus Navy and industry investments, and reduce total ownership cost. PEO Ships AM manages the SABER effort, responsible for protecting HM&E systems from cyber-attacks.

This PE serves as the bridge between Science and Technology (S&T) and ship platform and mission systems acquisition programs by identifying prospective applications for S&T research, advanced development, and performing additional product development and qualification when necessary to meet platform or mission system requirements. This PE also includes the HM&E cybersecurity SABER development. The HM&E systems to be protected from cyber-attack by SABER include Machinery Control Systems, steering control systems, Electric Power Systems, Damage Control and Firefighting, Auxiliary Machinery and Fluid Systems, Engines and Power Transmission Systems, Gas Turbine Systems, Video Systems, as well as other HM&E systems. SABER will allow the ship to better protect, detect, respond, and recover itself from a cyber-attack.

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 4: *Advanced Component Development & Prototypes (ACD&P)*	**R-1 Program Element (Number/Name)** PE 0603573N *I Advanced Surface Machinery Sys*

B. Program Change Summary ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	29.953	22.109	21.251	-	21.251
Current President's Budget	22.406	27.109	25.408	-	25.408
Total Adjustments	-7.547	5.000	4.157	-	4.157
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	5.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.458	0.000			
• Program Adjustments	0.000	0.000	4.299	-	4.299
• Rate/Misc Adjustments	0.000	0.000	-0.142	-	-0.142
• Congressional Directed Reductions Adjustments	-7.089	-	-	-	-

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2018	FY 2019
Project: 9999: *Congressional Adds*		
Congressional Add: *Silicon Carbide Power Modules*	0.000	5.000
Congressional Add Subtotals for Project: 9999	0.000	5.000
Congressional Add Totals for all Projects	0.000	5.000

Change Summary Explanation

The FY 2020 funding request was reduced by $2.086 million to account for the availability of prior year execution balances.

The increase in PU 2471, Integrated Power Systems, from FY 2019 to FY 2020 is to support development of the modular scalable multi-purpose Energy Magazine which enables new shipboard pulsed, high power directed energy weapons (lasers) and sensors.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603573N / *Advanced Surface Machinery Sys*	Project (Number/Name) 2471 / *Integrated Power Systems (IPS)*	

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
2471: *Integrated Power Systems (IPS)*	221.748	22.406	22.109	25.408	-	25.408	42.825	31.709	24.465	24.292	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project supports the development and transition of Naval Power and Energy Systems including power generation, power conversion, power distribution, energy storage, power utilization and automation and control functions for fully integrated electric propulsion (such as T-AKE -1 class or DDG 1000 class), hybrid electric propulsion (such as LHD 8 and LHA(R) class), as well as legacy mechanical propulsion ships (such as DDG51 class). This project supports optimized integration of Directed Energy (DE) and other high powered mission systems, appropriate component and system controls, integration of components and systems into future and current ships, and providing power and energy system solution alternatives to new and existing platforms. Existing ships' power systems require optimized integration via energy storage and advanced controls techniques to withstand the effects of DE and other high powered mission systems and avoid negative impacts to power generating equipment (diesel/gas turbine engines and generators).

Project developments are aligned with the Navy's 30 year shipbuilding plan via the Naval Power and Energy Systems Technology Development Roadmap (TDR), which outlines the way ahead for future developments and provides a basis for coordinated planning and investment by the Navy and private industry.

This project develops and transitions products that electrically integrate and provide power to mission systems, integrates those components and systems into ship platforms, increases energy efficiency, and provides cybersecurity capabilities for current in-service Hull, Mechanical and Electrical (HM&E) systems as well as future systems.

The systems developed by this Project are the power and energy foundation of the ships kill chain, and are developed with efficiency requirements as part of total life cycle cost minimization. Efforts within Power and Energy Systems are to design, develop, test and integrate shipboard power systems to incorporate advanced sensors, directed energy and other advanced weapons. Design and testing includes modeling and simulation, as well as land based testing, to reduce risk and demonstrate readiness for shipboard use.

Cybersecurity: Situational Awareness, Boundary Enforcement & Response (SABER) is a joint effort between PEO Ships, NAVSEA 21, PEO Carriers, NAVSEA 05Q (Afloat Cybersecurity Engineering Division), and supported by NSWC Philadelphia Division, to protect shipboard Hull, Mechanical, and Electrical (HM&E) systems from cyber-attacks. SABER will use different sensors to monitor the HM&E network and system communications to detect potential attacks. These sensors will feed information back to the central SABER Rack where Cyber Situational Awareness (SA) software will analyze the communications and produce alerts on any anomalies. SABER will also include Boundary Defense capabilities at points where communications come into the HM&E enclave from other enclaves or functional domains (e.g., Navigation, Combat, C4I, Aviation).

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603573N / *Advanced Surface Machinery Sys*	**Project (Number/Name)** 2471 / *Integrated Power Systems (IPS)*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: Power and Energy Systems	15.566	13.241	16.457	0.000	16.457
Articles:	-	-	-	-	-

FY 2019 Plans:

This PE has pursued an evolutionary energy storage development strategy for surface ships. Prior to FY 2019, this PE has designed, built, and tested the Energy Storage Module (ESM) prototype.

Energy Magazine (EM) Prototype: Execute an Engineering Change Proposal (ECP) to update the power electronics and battery cabinets to meet Navy qualification standards for ship installation. Specific FY 2019 efforts include design, ordering Long Lead Time Material (LLTM) as required, and commencing the build of the Energy Magazine (EM) prototype; and, commencing safety testing on redesigned battery modules.

Energy Magazine (EM): Develop technical specification, Acquisition Plan (AP) and Request For Proposal (RFP) for FY20 procurement of shipboard modular, scalable, multi-purpose Energy Magazine (EM) based on lessons learned from multiple related projects in energy storage, thermal management, circuit protection and controls.

Complete development of EM performance simulation models that capture the behavior of the system, conduct control system analysis, generate detailed interface requirements, and generate test scenarios and sequences.

Continue to identify requirements for Advanced Controls in order to take full advantage of the ship's power and energy resources to deliver to the mission systems the power and energy they require when required. Advanced controls configure the system to operate at max efficiency when appropriate and switch to max performance when necessary through three-way communication and control between the machinery control system, mission planning and pulsed high power and energy weapon systems and sensors. In FY 2019, this PE will evaluate and demonstrate the reduction in required energy storage that is achieved through the implementation of control methodologies that optimize the use and delivery of power to the mission loads.

Continue to conduct PHIL demonstrations. In FY 2019 PHIL demonstrations will focus on DDG 51 FLT III and future surface combatants with multiple high pulsed power loads; derisking EM, demonstrating advanced electrical architectures, power conversion equipment, and controls for implementation into an Integrated Power and Energy System (IPES).

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603573N / *Advanced Surface Machinery Sys*	**Project (Number/Name)** 2471 / *Integrated Power Systems (IPS)*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Conduct feasibility studies, cost based assessments, and begin developing technical and performance specifications for an Integrated Power & Energy System (IPES) in support of future surface combatant power and energy requirements. Identify shared energy storage and advanced controls requirements enabling an affordable, scalable and flexible power system to meet current and future needs. Refine IPES notional architectures and risk assessments through studies and industry engagement. Develop computer component models and commence system level modeling and simulation efforts. Plan for land based testing activities. Advanced Power Generation Modules (APGM): Continue to define performance requirements, explore trade space in next generation compact high power Advanced Power Generation Modules (APGM), develop characterization data used to conduct ship design studies and to establish a benchmark for performance comparison, develop a stand-alone technical description document which describes performance characteristics, evaluate the effect of large pulse loads from future electric weapons on the cycle life of gas turbine engines, and engine capability to respond to such pulse loads without an unacceptable reduction in time between overhaul. Specific FY19 efforts include utilizing previously developed Gas Turbine Generator (GTG) computer based model in a virtual IPES modeling environment with power system models. Further realistic simulations employing scaled APGM models will be run in a ship representative electrical architecture at Sandia National Laboratory to determine system interactions and stability. Advanced Power Conversion Module (APCM): Conduct feasibility studies, Cost Based Assessments, and begin developing performance and technical specifications for next generation compact high power Advanced Power Conversion Module (APCM) incorporating high band gap materials such as silicon carbide. Develop computer component models and commence system level modeling and simulation efforts.					
FY 2020 Base Plans: Increase warfighting capabilities using pulsed high power and energy weapons and sensors (i.e., lasers, advanced radars, etc.) require shipboard energy storage systems to provide a buffer between legacy ship electric distribution systems and the power and energy requirements of new generation weapons and sensors. This PE continues to pursue an evolutionary energy storage development strategy for surface ships. EM prototype: Complete safety testing on the redesigned battery modules. Complete build and commence electrical integration testing of the EM prototype. Support PEO IWS and ONR laser testing. Evaluate performance of the EM prototype and, as applicable, incorporate lessons learned into EM procurement.					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603573N / *Advanced Surface Machinery Sys*	**Project (Number/Name)** 2471 / *Integrated Power Systems (IPS)*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Energy Magazine (EM): Following source selection, award Energy Magazine (EM) contracts to up to two (2) vendors to fulfill the need for at least two (2) viable sources of supply for EM with domestic lithium ion batteries and power electronics for shipboard applications. In FY 2020, selected vendors will begin design of a modular, scalable, multi-purpose Energy Magazine (EM); an energy storage system that serves as the energy resource to enable the introduction of pulsed high power and energy weapons and sensor systems. EM simultaneously supports multiple pulsed loads such as laser, electronic warfare, radars, etc. When fully integrated, EM is expected to also reduce the number of Uninterruptable Power Supply (UPS) on ships which decreases maintenance and costs. The EM buffers and protects the ship power system while providing requisite power quality (specific dynamic interfaces (how quickly power/energy is required)) to support directed energy weapons and sensors. As part of EM development, this PE is pursuing a variety of energy storage media and a common interface to these various storage media for ease of interoperability and interchangeability in the future. Examples of energy storage media include advanced batteries (i.e., lithium iron phosphate), capacitors, ultra-capacitors, and flywheels. The EM aligns with PEO IWS plans for development and deployment of shipboard high power directed energy weapons and sensors. Conduct system simulations that focus on EM performance, generate detailed interface requirements, test scenarios and sequences, and incorporate in PHIL demonstration(s). Continue to identify requirements for Advanced Controls in order to take full advantage of power and energy resources within the ship's machinery control system and to deliver mission systems the power and energy they require when required. Advanced controls configure the system to operate at max efficiently when appropriate and switch to max performance when necessary through three-way communication and control between the machinery control system, mission planning and pulsed high power and energy weapon systems and sensors. In FY20 this PE will perform advance control optimization based on impact, availability, and resources with a focus on how to use controls to optimize the amount and cost of energy storage in the system taking into consideration stability and pulse-power support for determining energy storage needs. Continue to conduct PHIL demonstrations. In FY 2020 PHIL demonstrations will focus on a modular scalable multi-purpose Energy Magazine and future surface combatants with multiple high pulsed power loads;					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603573N / *Advanced Surface Machinery Sys*	**Project (Number/Name)** 2471 / *Integrated Power Systems (IPS)*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
demonstrating advanced electrical architectures, power conversion equipment, and controls for implementation into an Integrated Power and Energy System (IPES). Continue to conduct feasibility studies, cost based assessments, and develop technical and performance specifications for an Integrated Power & Energy System (IPES) in support of Future Surface Combatant power and energy requirements. Identify shared energy storage and advanced controls requirements enabling an affordable, scalable and flexible power system to meet current and future needs. Refine IPES notional architectures and risk assessments through studies and industry engagement. Draft performance specifications for IPES system, equipment and components. Execute computer component models and system level modeling and simulation efforts. Plan for land based testing activities. This PE will transition ONR Future Naval Capabilities (FNC) products, advanced circuit protection devices and Multi-Functional Energy Storage Module (MFESM). FY 2020 efforts include testing and documentation to transition into EM and APCM. Advanced Power Generation Modules (APGM): Continue to define performance requirements, explore trade space in next generation compact high power Advanced Power Generation Modules (APGM), continue to develop characterization data used to conduct ship design studies and to establish a benchmark for performance comparison, continue to develop a stand-alone technical description document which describes performance characteristics, continue to evaluate the effect of large pulse loads from future electric weapons on the cycle life of gas turbine engines, and engine capability to respond to such pulse loads without an unacceptable reduction in time between overhaul. Advanced Power Conversion Module (APCM): Continue to conduct feasibility studies, Cost Based Assessments, and developing performance and technical specifications for next generation compact high power Advanced Power Conversion Module (APCM) incorporating high band gap materials such as silicon carbide. Continue to develop computer component models and system level modeling and simulation efforts. FY 2020 efforts include evaluating the use of silicon carbide high band gap material in EM. ***FY 2020 OCO Plans:***					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603573N / *Advanced Surface Machinery Sys*	**Project (Number/Name)** 2471 / *Integrated Power Systems (IPS)*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
N/A					
FY 2019 to FY 2020 Increase/Decrease Statement: The increase from FY 2019 to FY 2020 is to support development of the modular scalable multi-purpose Energy Magazine which enables new shipboard pulsed, high power directed energy weapons (lasers) and sensors.					
Title: Naval Power Technology Development / Platform Integration & Transition	1.104	1.104	1.104	0.000	1.104
Articles:	-	-	-	-	-
FY 2019 Plans: Continue to execute the Advanced Electric Power and Propulsion Systems Development Project (short title is AEP3), Project Arrangement (PA) ref DoD-MOD-N-12-0001 which is an agreement between the US and UK Governments to cooperate on a scope of work associated with characterizing, developing, modeling, and de-risking electrical power and propulsion system architectures and equipment for future surface and submarine platforms to meet the needs of both Navies. Continue to develop power and propulsion system configurations in support of future surface ship acquisition programs. Develop alternative power and propulsion solutions for future surface combatants and amphibious ships. Continue to improve baseline power system performance by performing analysis, modeling and simulation, life cycle cost analysis, producibility studies, module development, and ship integration studies and planning. Continue to analyze alternatives for supplying power to advanced radars, combat systems, and electric weapons power demands and potential interfaces to develop optimum alternative solutions. Continue assessments of Naval Power and Energy System alternate architectures to best meet emerging ship requirements. Commence biennial update of the Naval Power and Energy Systems (NPES) Technology Development Roadmap (TDR). Continue to support maturation and transition of ONR Future Naval Capabilities (FNC) products to meet NPES TDR identified gaps. Support transition from ONR of Silicon Carbon (and other high bandgap semiconductor materials) based power electronic modules. High band gap semiconductor materials operate at high speeds and temperatures as					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603573N / *Advanced Surface Machinery Sys*	**Project (Number/Name)** 2471 / *Integrated Power Systems (IPS)*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
compared with silicon based materials affording more compact, thermally tolerant power conversion equipment making them highly desirable for naval applications. Continue Combat Power and Energy System Overarching Integrated Product Team (OIPT). Continue to generate strategy, technology development plan and resource requirements for future surface combatant integrated power and energy system. ***FY 2020 Base Plans:*** Continue to execute the Advanced Electric Power and Propulsion Systems Development Project (short title is AEP3), Project Arrangement (PA) ref DoD-MOD-N-12-0001 which is an agreement between the US and UK Governments to cooperate on a scope of work associated with characterizing, developing, modeling, and de-risking electrical power and propulsion system architectures and equipment for future surface and submarine platforms to meet the needs of both Navies. Continue to develop power and propulsion system configurations in support of future surface ship acquisition programs. Develop alternative power and propulsion solutions for future surface combatants and amphibious ships. Continue to improve baseline power system performance by performing analysis, modeling and simulation, life cycle cost analysis, producibility studies, module development, and ship integration studies and planning. Continue to analyze alternatives for supplying power to advanced radars, combat systems, and electric weapons power demands and potential interfaces to develop optimum alternative solutions. Continue assessments of Naval Power and Energy System alternate architectures to best meet emerging ship requirements. Complete biennial update of the Naval Power and Energy Systems (NPES) Technology Development Roadmap (TDR). Continue to support maturation and transition of ONR Future Naval Capabilities (FNC) products to meet NPES TDR identified gaps. Support transition from ONR of Silicon Carbon (and other high bandgap semiconductor materials) based power electronic modules. High band gap semiconductor materials operate at high speeds and temperatures as					

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603573N / *Advanced Surface Machinery Sys*	**Project (Number/Name)** 2471 / *Integrated Power Systems (IPS)*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
compared with silicon based materials affording more compact, thermally tolerant power conversion equipment making them highly desirable for naval applications. Continue Combat Power and Energy System Overarching Integrated Product Team (OIPT). Continue to generate strategy, technology development plan and resource requirements for future surface combatant integrated power and energy system. ***FY 2020 OCO Plans:*** N/A					
Title: Situational Awareness, Boundary Enforcement & Response (SABER) formerly referred to as Cybersecurity Boundary Defense Capability ***Articles:*** ***FY 2019 Plans:*** The plans for FY 2019 include monitoring the two NPCs and engaging with Ships Force to develop CONOPS for SABER. The lessons learned from the NPCs will support the continued development of the SA and BD software, along with HAVEN. Ship Change Documents and Ship Installation Drawings will be developed in support of FY 2020 installations. SABER system architectures will be developed for additional ship classes in support of installations in FY 2021. WeaselBoards for the DDG-51 class Universal Control Console and Data Interface Unit will be developed, and the Allen Bradley WeaselBoard will be re-designed based on the lessons learned from the EC and FADC designs. Contracts for the SABER Computing Hardware contract and for the SABER Taps & Aggregators will be awarded. The contractors will design the equipment and go through PDR/ CDR for each unit. Design and technical data packages for software and hardware solutions will be developed. Full-up SABER system architectures will be developed for the HM&E enclaves of the following ship classes: DDG-51 Flight III, LHD 1/7, LPD-17, LSD, LHA, and DDG 1000. R&D of a Cyber Fiber-wire Tap will begin, including light budget analysis of current HM&E fiber connections. A Job Duty Task Analysis (JDTA) and follow-on Front End Analysis (FEA) will be completed for the SABER system. ***FY 2020 Base Plans:*** The first production SABER Computing Hardware and SABER Taps & Aggregator units will be produced in FY 2020 to go through First Article Testing (FAT) to support full production for the first two installations in Q4 FY 2020 and installations scheduled for FY 2021. SA and BD software development will continue, with evaluation of additional software products to add capabilities to the overall SABER portfolio. A WeaselBoard for	5.736 -	7.764 -	7.847 -	0.000 -	7.847 -

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603573N / *Advanced Surface Machinery Sys*	**Project (Number/Name)** 2471 / *Integrated Power Systems (IPS)*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Siemens PLCs will be developed. SABER system architectures will be developed for the remaining ship classes (installations in FY 2022 and beyond). ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Increase is associated with testing in support of planned permanent installations.					
Accomplishments/Planned Programs Subtotals	22.406	22.109	25.408	0.000	25.408

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

This program develops and transitions higher performance and more affordable electric power and propulsion systems to both new construction and back fit ship applications using an evolutionary acquisition approach. For new contract awards, full and open competition is utilized to the maximum extent possible to provide maximum benefit to the Navy at the lowest possible cost to the taxpayer. When able to meet Navy requirements, commercial technology is leveraged to further minimize cost to the Navy. SABER efforts will maximize use of government field activity labs and HM&E equipment vendors. SABER will use SA and BD software tools with Government Purpose Rights or those which are open source as much as possible

E. Performance Metrics

This project will execute 100% of the signed Technology Deployment Agreements with ONR; complete 100% of the advanced developments currently planned for the Energy Storage Module and Power Generation Module; achieve up to 10% Specific Fuel Consumption (SFC) improvement for Advanced Power Generation Module; mature technology to Technology Readiness Level (TRL) 6 by milestone decisions for ship acquisition program; and, complete design and development of Situational Awareness, Boundary Enforcement & Response (SABER) to protect HM&E systems on surface ships from cyber-attacks in alignment with the Task Force Cyber Awareness (TFCA) goals.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603573N / *Advanced Surface Machinery Sys*	Project (Number/Name) 2471 / *Integrated Power Systems (IPS)*	

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Product Development	SS/FFP	Rolls Royce : Walpole, MA	36.397	1.506	Oct 2017	0.000		0.000		-		0.000	Continuing	Continuing	Continuing
Product Development	TBD	TBD : TBD	0.000	0.000		0.000		2.000	Apr 2020	-		2.000	0.000	2.000	-
Product Development	C/FFP	DRS : DRS, Milwaukee WI	45.933	2.887	Dec 2017	5.118	Mar 2019	6.607	Oct 2019	-		6.607	Continuing	Continuing	Continuing
Product Development	C/CPFF	Various : Various	41.753	5.747	Oct 2017	4.222	Oct 2018	4.000	Oct 2019	-		4.000	Continuing	Continuing	Continuing
Product Development	WR	NSWCPD : Phila, PA	56.467	4.530	Oct 2017	3.505	Oct 2018	3.370	Oct 2019	-		3.370	Continuing	Continuing	Continuing
Cybersecurity	WR	NSWCPD : Phila, PA	4.223	4.020	Nov 2017	1.250	Nov 2018	3.500	Nov 2019	-		3.500	Continuing	Continuing	Continuing
Cybersecurity	C/CPIF	Boeing : Huntington Beach, CA	0.700	0.300	Jan 2018	0.250	Feb 2019	0.250	Jan 2020	-		0.250	Continuing	Continuing	Continuing
Cybersecurity	C/FP	Various HM&E Equipment Vendors : Various	1.998	0.000		0.000		0.250	Jan 2020	-		0.250	Continuing	Continuing	Continuing
Cybersecurity	C/CPIF	Various : Various	3.000	0.266	Jan 2018	0.264	Jan 2019	0.347	Jan 2020	-		0.347	Continuing	Continuing	Continuing
Cybersecurity	C/CPFF	TBD Comp HW : TBD	0.000	0.000		4.000	Feb 2019	2.000	Nov 2019	-		2.000	0.000	6.000	-
Cybersecurity	C/CPFF	JHU APL : Laurel, MD	2.231	0.400	Jan 2018	0.250	Dec 2018	0.500	Jan 2020	-		0.500	0.000	3.381	-
Cybersecurity	C/CPFF	TBD Tap-Agg : TBD	0.000	0.000		1.250	Apr 2019	0.500	Nov 2019	-		0.500	0.000	1.750	-
Cybersecurity	MIPR	Sandia National Labs : Albuquerque, NM	0.000	0.750	Nov 2018	0.500	Nov 2018	0.500	Nov 2019	-		0.500	0.000	1.750	-
		Subtotal	192.702	20.406		20.609		23.824		-		23.824	Continuing	Continuing	N/A

Test and Evaluation ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Test and Evaluation	WR	NSWCCD-SSES : Phila, PA	24.954	0.000		0.000		0.000		-		0.000	Continuing	Continuing	Continuing
		Subtotal	24.954	0.000		0.000		0.000		-		0.000	Continuing	Continuing	N/A

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603573N / *Advanced Surface Machinery Sys*	Project (Number/Name) 2471 / *Integrated Power Systems (IPS)*	

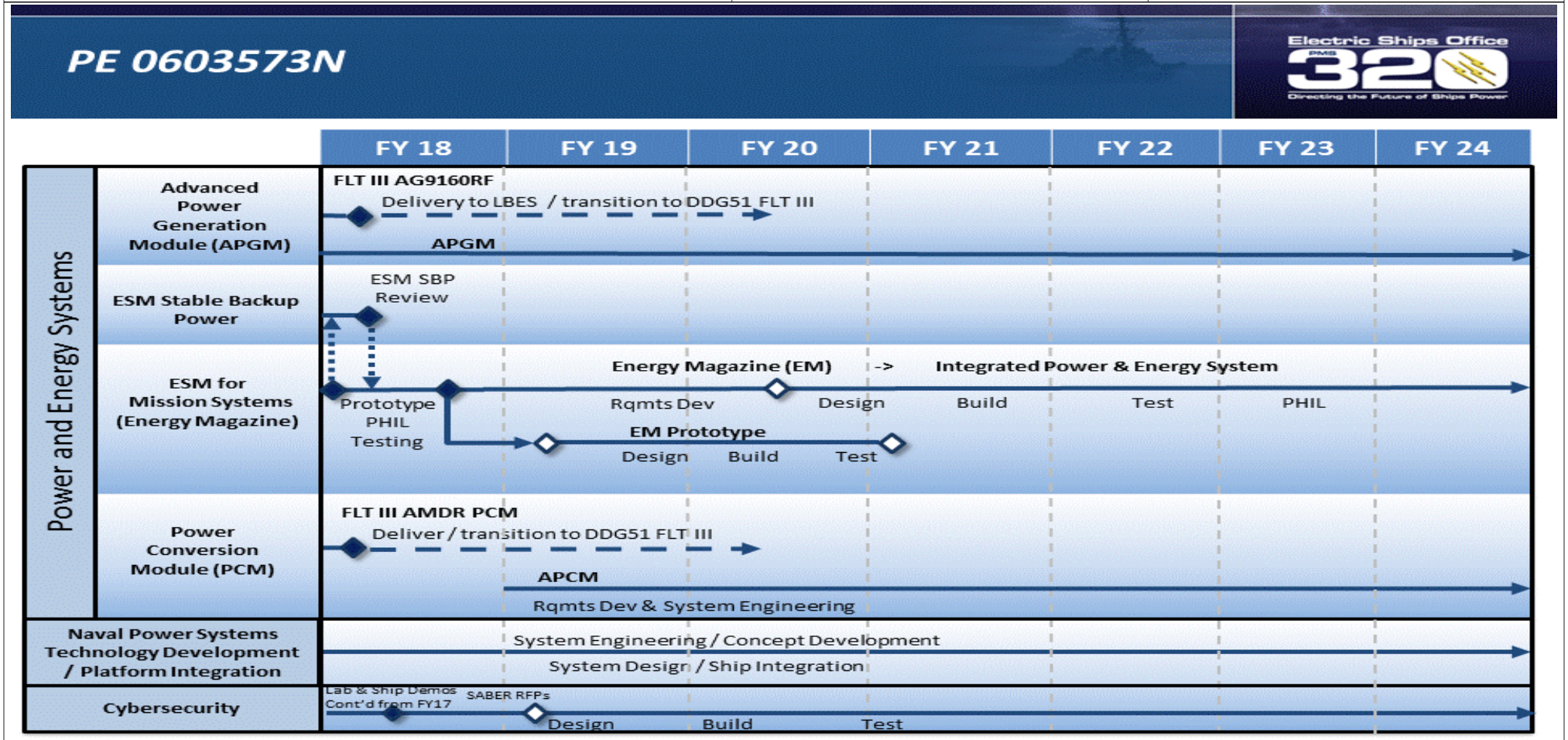
Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Management	C/CPFF	Herren Associates : Alexandria, VA	4.092	2.000	Dec 2017	1.500	Oct 2018	1.584	Oct 2019	-		1.584	Continuing	Continuing	Continuing
		Subtotal	4.092	2.000		1.500		1.584		-		1.584	Continuing	Continuing	N/A

	Prior Years	FY 2018		FY 2019		FY 2020 Base		FY 2020 OCO		FY 2020 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	221.748	22.406		22.109		25.408		-		25.408	Continuing	Continuing	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603573N / *Advanced Surface Machinery Sys*	**Project (Number/Name)** 2471 / *Integrated Power Systems (IPS)*



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1

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603573N / *Advanced Surface Machinery Sys*	**Project (Number/Name)** 2471 / *Integrated Power Systems (IPS)*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Proj 2471				
Power and Energy Systems	1	2018	4	2024
Naval Power Technology Development / Platforms Integration & transition	1	2018	4	2024
Situational Awareness, Boundary Enforcement & Response (SABER) previously Cybersecurity BDC	1	2018	4	2024

Exhibit R-2A, RDT&E Project Justification: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603573N / *Advanced Surface Machinery Sys*	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	0.000	5.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.000
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Silicon Carbide Power Electronics. The Committee supports the Navy's investment to develop advanced power and energy technology to meet requirements for higher electric power loads through efficient means. The Committee understands that use of silicon carbide power modules may reduce the size and weight of power conversion modules and other electronic systems necessary for advanced sensors and weapon systems. The Committee recommends $5,000,000 for silicon carbide power electronics research and encourages the Secretary of the Navy to continue to invest in advanced power and energy technology and accelerate the qualification of silicon carbide power modules to be used on high power, mission critical Navy platforms.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019
Congressional Add: Silicon Carbide Power Modules	0.000	5.000
FY 2018 Accomplishments: N/A		
FY 2019 Plans: Commence development of requirements and Silicon Carbide (SiC) Power Converter Simulation, Medium Voltage (MV) SiC Semiconductor Module Refinement and Validation, and MV SiC Semiconductor Module Endurance Test and Prototype Power Converter Development		
Congressional Adds Subtotals	0.000	5.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Execute 100% of the intent of the FY 2019 Congressional Add to develop advanced power and energy technology to meet requirements for higher electric power loads through efficient means such as silicon carbide power modules which may reduce the size and weight of power conversion modules and other systems necessary for advanced sensors and weapon systems.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2020 Navy			Date: March 2019
Appropriation/Budget Activity 1319 / 4	R-1 Program Element (Number/Name) PE 0603573N / *Advanced Surface Machinery Sys*	Project (Number/Name) 9999 / *Congressional Adds*	

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
SiC Power Modules	C/CPFF	TBD : TBD	0.000	0.000		4.750	Feb 2019	0.000		-		0.000	0.000	4.750	-
SiC Power Modules	WR	Naval Surface Warfare Center : Phila., PA	0.000	0.000		0.250	Feb 2019	0.000		-		0.000	0.000	0.250	-
		Subtotal	0.000	0.000		5.000		0.000		-		0.000	0.000	5.000	N/A

	Prior Years	FY 2018 Cost	FY 2018 Award Date	FY 2019 Cost	FY 2019 Award Date	FY 2020 Base Cost	FY 2020 Base Award Date	FY 2020 OCO Cost	FY 2020 OCO Award Date	FY 2020 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	0.000	0.000		5.000		0.000		-		0.000	0.000	5.000	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603573N / *Advanced Surface Machinery Sys*	**Project (Number/Name)** 9999 / *Congressional Adds*

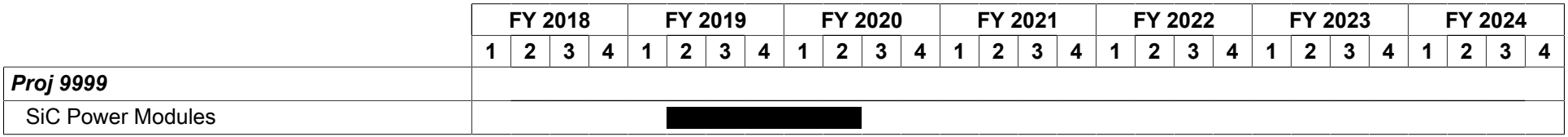

Exhibit R-4A, RDT&E Schedule Details: PB 2020 Navy		Date: March 2019
Appropriation/Budget Activity 1319 / 4	**R-1 Program Element (Number/Name)** PE 0603573N / *Advanced Surface Machinery Sys*	**Project (Number/Name)** 9999 / *Congressional Adds*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Proj 9999				
SiC Power Modules	2	2019	2	2020