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 0603271N *I Electromagnetic Systems 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	9.231	8.804	9.499	-	9.499	8.008	8.169	8.336	8.503	Continuing	Continuing
2913: *Electromagnetic Systems Advanced Technology*	0.000	9.231	8.804	9.499	-	9.499	8.008	8.169	8.336	8.503	Continuing	Continuing

A. Mission Description and Budget Item Justification

The activities described in this PE address future Navy and Marine Corps capabilities needed to maintain maritime superiority and ensure national security. They are based on input from Naval Research Enterprise stakeholders (including the Naval enterprises, the combatant commands, OPNAV and Headquarters Marine Corps) and are designed to exploit breakthroughs in science and technology in order to deliver maximum warfighting benefit to our sailors and marines. These efforts are aligned with shared priorities throughout the whole of RDT&E in order to quickly advance new capabilities from discovery to deployment across the warfighting domains.

Activities and efforts in this PE address technologies critical to enabling the transformation of discrete functions to network centric warfare capabilities, which simultaneously perform Radar, Electronic Warfare (EW), and Communications and Network functions across platforms through multiple, simultaneous and continuous communications/data links. The Electromagnetic Systems Advanced Technology program addresses Radio Frequency (RF) technology for Surface and Aerospace Surveillance sensors and systems, EW sensors and systems, RF Communication Systems, Multi-Function sensor systems, and Position, Navigation and Timing (PNT) capabilities. Within the Naval Transformational Roadmap, this investment offers affordable options for the transformational capabilities required by the Sea Shield (Theater Air and Missile Defense), Sea Strike (Persistent Intelligence, Surveillance, and Reconnaissance), and ForceNet (Communications and Networking) SeaPower 21 Naval Warfighting Pillars.

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	9.360	0.000	0.000	-	0.000
Current President's Budget	9.231	8.804	9.499	-	9.499
Total Adjustments	-0.129	8.804	9.499	-	9.499
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	8.804			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.117	0.000			
• Program Adjustments	0.000	0.000	9.499	-	9.499
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000

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• Congressional General Reductions Adjustments	-0.012	-	-	-	-

Change Summary Explanation

The change from FY19 to FY20 reflects increased investment in Global Positioning System (GPS) and Navigation Technology.

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 0603271N / *Electromagnetic Systems Advanced Technology*				Project (Number/Name) 2913 / *Electromagnetic Systems 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**
2913: *Electromagnetic Systems Advanced Technology*	0.000	9.231	8.804	9.499	-	9.499	8.008	8.169	8.336	8.503	Continuing	Continuing

A. Mission Description and Budget Item Justification

Work in this project addresses cost-effective Radio Frequency (RF) technology for Surface and Aerospace Surveillance sensors and systems, Electronic Warfare (EW) sensors and systems, RF Communication Systems, Multi-Function sensor systems, and Position, Navigation and Timing (PNT) capabilities.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Title: ELECTRONIC AND ELECTROMAGNETIC SYSTEMS	5.169	4.204	4.180	0.000	4.180
Description: The overarching objective of the Electronic and Electromagnetic Systems Activity is to develop, test, and demonstrate Communications, Electronic Attack (EA), Electronic Surveillance (ES), Electronic Warfare (EW), and Radar functions. A portion of this PE is devoted to mid-term technology development in close concert with acquisition programs of record. The products of these efforts are planned for transition at the end of their schedule into the associated acquisition program of record. Major thrust within the Electronics and Electromagnetic Systems program are: a) Advanced EW Enabling Technologies - Develop classified advanced electronic warfare technology in support of current and predicted capability requirements. ***FY 2019 Plans:*** Continue research in the areas of improved threat warning systems; electronic warfare support (ES); decoys and countermeasures against weapon tracking and guidance systems; electronic attack (EA) against adversary command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR); and electronic protection (EP) of our own weapons and C4ISR from intentional and unintentional interference to control the electromagnetic spectrum (EMS) by exploiting, deceiving, or denying enemy use of the spectrum while ensuring its use by friendly forces. ***FY 2020 Base Plans:*** COnduct research in the areas of improved threat warning systems; electronic warfare support (ES); decoys and countermeasures against weapon tracking and guidance systems; electronic attack (EA) against adversary command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR); and electronic protection (EP) of our own weapons and C4ISR from intentional and unintentional interference to					

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 0603271N / *Electromagnetic Systems Advanced Technology*	**Project (Number/Name)** 2913 / *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
control the electromagnetic spectrum (EMS) by exploiting, deceiving, or denying enemy use of the spectrum while ensuring its use by friendly forces. Refine design of and implement next-generation electronic warfare development and evaluation capability for the Navy (classified details available). Employ the updated capability for real-world assessments of existing electronic warfare and sensor system performance. Conduct analysis of results of FY19 test and evaluation activities. Refine and modify designs based on results, and initiate implementation of modified and additional capabilities. Continue close coordination with associated S&T and acquisition programs. ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** No significant change between FY 2019 and FY 2020					
Title: GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY	4.062	4.600	5.319	0.000	5.319
Description: The overarching objective of this activity is to develop technologies that enable the development of affordable, effective and robust Position, Navigation and Timing (PNT) capabilities using either GPS systems, non-GPS navigation devices, or atomic clocks. This activity will increase the operational effectiveness of U.S. Naval units. The focus is on the mitigation of GPS electronic threats, the development of atomic clocks that possess unique long-term stability and precision, and the development of compact, low-cost, Inertial Navigation Systems (INS). The following are non-inclusive examples for projects funded in this activity. As a result of a comprehensive DOD wide assessment of current S&T investments in the area of Position, Navigation and Timing, there has been increased investment in the Global Positioning System (GPS) & Navigation Technology thrust for Assured Time Dissemination research. ***FY 2019 Plans:*** Conduct advanced research and development in position, navigation and timing. This research aims to develop devices and systems that provide assured, cost-effective, and mission relevant PNT to the warfighter. Areas of investment included robust GPS, non-GPS navigation aids, and assured timekeeping. Specifically, research that enables robust integrity checking and monitoring of GPS in the presence of electronic threats and anti-spoofer/ anti-jam processors for the purpose of providing precision navigation capabilities in the presence of emergent threats; atomic clocks that possess unique long-term stability and precision for the purpose of providing GPS-independent precision time as well as time-transfer techniques for the purpose of providing GPS-independent					

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Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603271N / *Electromagnetic Systems Advanced Technology*	**Project (Number/Name)** 2913 / *Electromagnetic Systems Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
precision time; and Inertial navigation systems for the purpose of providing an alternative means of providing precision navigation, correlation navigation technique using high precision earth maps, for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals. ***FY 2020 Base Plans:*** Conduct advanced research and development in position, navigation and timing. This research aims to develop techniques and technology to provide assured, cost-effective, and mission relevant PNT to the warfighter. Areas of investment included robust GPS, non-GPS navigation aids, and assured timekeeping. Specifically, GPS Anti-Jam Antennas and Receivers for Navy platforms for the purpose of providing precision navigation capabilities in the presence of electronic threats and anti-spoofer/anti-jam processors for the purpose of providing precision navigation capabilities in the presence of emergent threats; Tactical grade atomic clocks that possess unique long-term stability and precision for the purpose of providing GPS-independent precision time and transferring UTC(USNO) time via alternative electromagnetic links for the purpose of providing GPS-independent precision time; and Inertial navigation systems for the purpose of providing an alternative means of providing precision navigation, a correlation navigation technique using earth maps of high precision, for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals. ***FY 2020 OCO Plans:*** N/A ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The funding increase from FY 2019 and FY 2020 is for increased investment in Assured Time Dissemination research in the Global Positioning System (GPS) and Navigation Technology thrust. This increase comes as a result of a comprehensive DOD wide assessment of current S&T investments in the area of Position, Navigation and Timing.					
Accomplishments/Planned Programs Subtotals	9.231	8.804	9.499	0.000	9.499

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 0603271N / *Electromagnetic Systems Advanced Technology*	**Project (Number/Name)** 2913 / *Electromagnetic Systems Advanced Technology*

E. Performance Metrics

Advanced Electronic Sensor Systems for Missile Defense and Long Range Detection and Tracking ECs are aligned to the Navy's Advanced Cruiser (CG(X)) plans and closely coordinated with Naval Sea Systems Command Integrated Warfare Systems (PEO IWS 2.0). Other performance metrics are discussed within the R-2a. Navigation and timekeeping developments are aligned and coordinated to the OPNAV (N2N6E4) Assured PNT plan for surface and aviation platforms and with the Special Programs office's technology development roadmap.