Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy											Date: March 2014	
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 2013**	**FY 2014**	**FY 2015 Base**	**FY 2015 OCO #**	**FY 2015 Total**	**FY 2016**	**FY 2017**	**FY 2018**	**FY 2019**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	60.098	56.179	64.623	-	64.623	24.911	20.576	14.289	13.212	Continuing	Continuing
2913: *Electromagnetic Systems Advanced Technology*	0.000	51.848	56.179	64.623	-	64.623	24.911	20.576	14.289	13.212	Continuing	Continuing
9999: *Congressional Adds*	0.000	8.250	-	-	-	-	-	-	-	-	-	8.250

The FY 2015 OCO Request will be submitted at a later date.

Note

FY 2013 funding and associated Future Naval Capability (FNC) efforts addressed in this Program Element (PE) are transferring to a new PE titled Future Naval Capabilities Advanced Technology Development (PE 0603673N). This is to enhance the visibility of the FNC Program by providing an easily navigable and consolidated overview of all 6.3 FNC investments in a single PE.

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 (Sep 2011). 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.

Activities and efforts in this Program Element (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.

Exhibit R-2, RDT&E Budget Item Justification: PB 2015 Navy	Date: March 2014
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*

B. Program Change Summary ($ in Millions)	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO	FY 2015 Total
Previous President's Budget	54.858	56.179	71.268	-	71.268
Current President's Budget	60.098	56.179	64.623	-	64.623
Total Adjustments	5.240	-	-6.645	-	-6.645
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	1.631	-			
• SBIR/STTR Transfer	-0.681	-			
• Program Adjustments	-	-	-6.645	-	-6.645
• Rate/Misc Adjustments	-0.001	-	-	-	-
• Congressional General Reductions Adjustments	-4.709	-	-	-	-
• Congressional Add Adjustments	9.000	-	-	-	-

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2013	FY 2014
Project: 9999: *Congressional Adds*		
Congressional Add: *Adv Radar Innovation Fund - S&T (Cong)*	8.250	-
Congressional Add Subtotals for Project: 9999	8.250	-
Congressional Add Totals for all Projects	8.250	-

Change Summary Explanation

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy			Date: March 2014
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 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
2913: *Electromagnetic Systems Advanced Technology*	-	51.848	56.179	64.623	-	64.623	24.911	20.576	14.289	13.212	Continuing	Continuing

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

Work in this project addresses cost-effective 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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014	FY 2015
Title: ELECTRONIC AND ELECTROMAGNETIC SYSTEMS	1.496	4.227	3.259

Description: The overarching objective of this activity is to develop, test, and demonstrate communications, electronic attack (EA), electronic surveillance (ES), electronic warfare (EW), and radar functions. This activity also includes development of affordable wideband, high performance Advanced Multifunction Radio Frequency (AMRF) apertures. 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 expected to transition at the end of their schedule into the associated acquisition program of record.

a) Electronic Warfare (EW) Roadmap - Develop classified advanced electronic warfare technology in support of current and predicted capability requirements.
b) Integrated Topside (InTop): Develop wide-band array and electronic systems to support EW capability and other functions, including but not limited to IO and LOS Comms, for surface combatants with potential application to other platforms.

The increase from FY 2013 to FY 2014 is due to funds provided only in FY 2014 to accelerate the development of Integrated Topside (InTop) efforts.

The decrease from FY 2014 to FY 2015 is due to funds provided only in FY 2014 to accelerate the development of Integrated Topside (InTop) efforts were not available in FY2015.

The following are non-inclusive examples of accomplishments and plans for projects funded in this activity.

FY 2013 Accomplishments:
FY 2013 Accomplishments:
Electronic Warfare (EW) Roadmap:

Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy		Date: March 2014
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 2013	FY 2014	FY 2015
- Continued development of classified advanced electronic warfare technology in support of current and predicted capability requirements. ***FY 2014 Plans:*** Electronic Warfare (EW) Roadmap: - Continue all efforts of FY 2013 less those noted as completed. Integrated Topside (InTop): - Initiate and complete development of GENSER IO Surrogate - Initiate and complete integration of IO Surrogate with Integrated Topside (InTop) ***FY 2015 Plans:*** Electronic Warfare (EW) Roadmap: - Continue all efforts of FY 2014 less those noted as completed.			
Title: GLOBAL POSITIONING SYSTEM (GPS) & NAVIGATION TECHNOLOGY	4.075	2.263	2.307
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 major objectives of this activity are: a) GPS Anti-Jam Antennas and Receivers - Integrate and demonstrate anti-jam antennas and antenna electronics for Navy platforms for the purpose of providing precision navigation capabilities in the presence of electronic threats; to integrate and demonstrate anti-spoofer/anti-jam processors for the purpose of providing precision navigation capabilities in the presence of emergent threats. b) Precision Time and Time Transfer - Integrate and demonstrate tactical grade atomic clocks that possess unique long-term stability and precision for the purpose of providing GPS-independent precision time; to integrate and demonstrate the capability of transferring GPS-derived time via radio frequency links for the purpose of providing GPS-independent precision time. c) Non-GPS Navigation Technology - To integrate and demonstrate inertial navigation systems for the purpose of providing an alternative means of providing precision navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals; to integrate and demonstrate a correlation navigation technique using earth maps of high precision (including bathymetric, magnetic and gravimetric data) for navigation for those Naval platforms which may not have GPS navigation capabilities and/or loss of GPS signals.			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy		Date: March 2014
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 2013	FY 2014	FY 2015
The decrease in funding from FY 2013 to FY 2014 is due to the reduced investment in Advanced Technology efforts for GPS and Navigation, and planned increase in Applied Research investment in the Navigation Technology activity in PE 0602271N. The following are non-inclusive examples for projects funded in this activity. ***FY 2013 Accomplishments:*** GPS Anti-Jam Antennas and Receivers: - Continued development of Small Antenna Based Anti-spoofing project. - Continued development of Advanced Spoofer Tracking. - Continued development of Next Generation Global Positioning Satellite System - Situational Awareness (XGPSS-SA) Challenged Environment. - Continued Modernized Receiver for RF Challenged Environments. - Continued development of the Simulation of GPS Signals in a Stressed Environment. - Continued development of Self Calibrating GPS AJ Antennas for Electronic Support. - Continued and completed Accurate Cooperative Geolocation System. - Initiated Application of National Airspace Air Traffic Control (ATC) Automatic Dependant Surveillance Broadcast (ADS-B) project. - Initiated Cognitive Modernized GPS User Equipment (MGUE) for GPS-Denied Environments project. Precision Time and Time Transfer: - Continued development of algorithms for distributed time scaling; developed architectures necessary to establish a Navy Global Coordinated Time Scale; tested the algorithms via both simulation and using actual clock data provided by the U.S. Naval Observatory (USNO). - Continued development and Distributing Time-frequency Device. - Continued development of Rb 3-cc Tactical Grade Atomic Clock (TGAC). - Initiated Ultra-Precise Timing Using GPS (UPTUG) Project. Non-GPS Navigation Technology: - Continued Optically Transduced MEMS Inertial Navigation System project. - Continued Sub-harmonic Lateral Mode MEMS Inertial Navigation System project. - Continued Two-Axis Gyro-compass Fiber Optic Inertial Navigation System project. - Continued development of Wavewinds project. - Continued development of Small Unmanned Underwater Vehicle - Sonar Aided Inertial Navigation Technology (UUV-SAINT) project.			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy		Date: March 2014
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 2013	FY 2014	FY 2015
- Continued development of Portable PCNS project. - Continued development of Superconducting Magnetometer On-Board Navigation (SIMON) System. - Continued development of Alternative Navigation Over Unstructured or Featureless Terrain. - Completed development of a small, lightweight Micro-Electro-Mechanical Systems (MEMS) Accelerometer for navigation systems; and fabricated an Electro-Optic Accelerometer.			
FY 2014 Plans: GPS Anti-Jam Antennas and Receivers: - Continue all efforts of FY 2013 less those noted as completed. - Complete Application of National Airspace Air Traffic Control (ATC) Automatic Dependant Surveillance Broadcast (ADS-B) project. - Initiate GPS Antenna System for Enhanced EP, ES and Precise Navigation. Precision Time and Time Transfer: - Continue all efforts of FY 2013 less those noted as completed. - Complete Ultra-Precise Timing Using GPS (UPTUG) Project. - Initiate DoD master clock time transfer via optical fibers. Non-GPS Navigation Technology: - Continue all efforts of FY 2013 less those noted as completed. - Complete Modernized Integrated Spoofer Tracking (MIST) Prototype. - Complete Hollow-core Fiber Optic Inertial Navigation System. - Initiate Two-Axis Fiber Optic Inertial Navigation System Phase II project. - Initiate Mechanical System (MEMS) Inertial Navigation System (INS) Phase II project. - Initiate Angle-Only Infra Red Celestial Navigation System.			
FY 2015 Plans: GPS Anti-Jam Antennas and Receivers: - Continue all efforts of FY 2014 less those noted as completed. Precision Time and Time Transfer: - Continue all efforts of FY 2014 less those noted as completed. - Initiate Tactical Grade Atomic Clock. Non-GPS Navigation Technology:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy		Date: March 2014
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 2013	FY 2014	FY 2015
- Continue all efforts of FY 2014 less those noted as completed. - Initiate Miniature Ultra-Cold Atom Chip Inertial Sensors. - Complete Precise At-Sea Ship's Indoor Outdoor Navigation (PASSION).			
Title: INTEGRATED TOPSIDE (INTOP) INNOVATIVE NAVAL PROTOTYPE (INP) ***Description:*** The overarching objective of the INTOP INP is to develop and demonstrate a set of prototypes that integrate RF functionality (EW, Radar, Communications, Navigation) into a common set of multi-function apertures electronics and software through an architecture that is modular, scalable across all platforms, and open at the RF as well as computer and software level. The apertures are capable of providing multiple simultaneous, independent beams which can together perform any of the above functions. The major objectives of this activity are: a) Submarine SATCOM Array - Develop wide-band SATCOM array capable of supporting EW for submarines. b) Electronic Warfare (EW)/Information Operations (IO)/Line of Sight (LOS) Communications (Comms) for Surface Combatants - Develop wide-band array to support EW capability and other functions, including but not limited to IO and LOS Comms, for surface combatants with potential application to other platforms. c) Architecture, Standards and Devices - Develop architecture and standards for wide-band multi-beam, multi-band arrays and below deck systems and the technology and electronic devices needed to make integrated array systems affordable. d) Surface Combatant Communication Array - Develop wide-band surface combatant communication array capable of supporting other RF functions. e) Resource Allocation Manager - Develop enterprise common Resource Allocation Manager. f) Digital Radar - Develop an all digital radar to demonstrate advanced concepts for coherent radar networking and control, which will increase radar coverage and provide new levels of electronic protection (EP), while maximizing radar resources and reducing cost. g) Low Band Communications, IO and EW - Develop low band technology development and concept studies leading to development of an Advanced Development Model (ADM).	46.277	49.689	49.907

Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy		Date: March 2014
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 2013	FY 2014	FY 2015
The increase in funding from FY2014 to FY2015 is to design and develop the LowRIDR to cover the bands below SEWIP Block III, to build the highly adaptable FLEXDAR Radar. The following are non-inclusive examples of accomplishments and plans for projects funded in this activity. ***FY 2013 Accomplishments:*** Submarine SATCOM Array: - Continued development of prototype build. - Continued integration and test program. EW/IO/Comms for Surface Combatants: - Continued development of prototype capability. - Continued development of the EW/IO/COMMS prototype. - Initiated demonstration of technologies and subsystems for EW/IO/Comms prototype. Architecture, Standards and Devices: - Continued development of deckhouse and platform integration strategies and concepts. - Continued SEWIP Block III Prototype, a multi-function RF topside aperture prototype covering approximately 200MHz to 22 GHz and providing the appropriate control and synergy of the functionality, such that the RF functions automatically support one another, providing improved operational capability. Additionally, demonstrate reductions in size, weight, and power as well as cost (both acquisition and life cycle) by reducing the number of topside apertures needed for communication, electronic warfare, and some radar functions. A critical tenet of the prototype will be the demonstration of an open architecture so that not only can different companies supply the major components, such as a given receive or transmit aperture, but even down to the subarray and lower component level throughout the life cycle, to ensure continuing competition for maintenance and replacement parts. - Completed development of architecture and interfaces and their application to wide-band SATCOM arrays for submarines. Surface Combatant Satellite Communications Array: - Continued design effort. Resource Allocation Manager: - Completed development of RAM software and infrastructure. - Initiated integration and test of RAM. Digital Radar:			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy		Date: March 2014
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 2013	FY 2014	FY 2015
- Continued design effort. Low Band Communications, IO and EW: Low Band Communications, IO and EW: - Initiate development of the initial architecture and requirements. ***FY 2014 Plans:*** Submarine SATCOM Array: - Continue all efforts of FY 2013 less those noted as complete above. - Complete prototype build. EW/IO/Comms for Surface Combatants: - Continue all efforts of FY 2013 less those noted as complete above. - Complete development of EW/IO/Comms prototype. - Complete demonstration of technologies and subsystems for EW/IO/Comms prototype. - Initiate integration and test of ADM. Architecture, Standards and Devices: - Continue all efforts of FY 2013 less those noted as complete above. - Complete SEWIP Block III Prototype Surface Combatants Satellite Communications Array: - Continue all efforts of FY 2013 less those noted as complete above. Resource Allocation Manager: - Continue all efforts of FY 2013 less those noted as complete above. Digital Radar: - Continue all efforts of FY 2013 less those noted as complete above. - Initiate system build for back-end. - Initiate system design for front-end. Low Band Communications, IO and EW: - Continue all efforts of FY 2013 less those noted as complete above. ***FY 2015 Plans:***			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy		Date: March 2014
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 2013	FY 2014	FY 2015
Submarine SATCOM Array: - Continue all efforts of FY 2014 less those noted as complete above. - Complete integration and test. EW/IO/Comms for Surface Combatants: - Continue all efforts of FY 2014 less those noted as complete above. - Complete integration and test of ADM. Architecture, Standards and Devices: - Continue all efforts of FY 2014 less those noted as complete above. Surface Combatants Satellite Communications Array: - Continue all efforts of FY 2014 less those noted as complete above. Resource Allocation Manager: - Continue all efforts of FY 2014 less those noted as complete above. Digital Radar: - Continue all efforts of FY 2014 less those noted as complete above. - Complete system design for front-end. - Initiate system build for front-end. Low Band Communications, IO and EW: - Continue all efforts of FY 2014 less those noted as complete above. - Complete architecture and requirements. - Initiate subsystem designs.			
Title: Netted Emulation of Multi-Element Signatures against Integrated Sensors (NEMESIS)	-	-	9.150
Description: The objective is to develop a System of Systems (SoS) able to coordinate distribute EW resources against many adversary surveillance and targeting sensors simultaneously. It will benefit the warfighter by providing platform protection across the battlespace against many sensors, creating seamless cross-domain countermeasure coordination, and enabling rapid advanced technology/capability insertion to counter emerging threats.			

Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy		Date: March 2014
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 2013	FY 2014	FY 2015
a) Develop reconfigurable and modular EW payloads, Distributed Decoy and Jammer Swarms (DDJS), effective multi-spectral countermeasures (CM), and Multiple Input/Multiple Output Sensor/CM (MIMO S/CM) for platform protection across operational domains. This R2 activity was initiated in FY 2014 in PE 0602271N and expanded in FY2015 to PE 0603271N. ***FY 2013 Accomplishments:*** N/A ***FY 2014 Plans:*** N/A ***FY 2015 Plans:*** - Initiate development and demonstration of the NEMESIS EW payloads and their integration into platforms. - Initiate application of the research supporting distributed control, coordination and networking of NEMESIS payloads and platforms.			
Accomplishments/Planned Programs Subtotals	51.848	56.179	64.623

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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.

Exhibit R-2A, RDT&E Project Justification: PB 2015 Navy			Date: March 2014
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603271N / *Electromagnetic Systems Advanced Technology*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2013	FY 2014	FY 2015 Base	FY 2015 OCO #	FY 2015 Total	FY 2016	FY 2017	FY 2018	FY 2019	Cost To Complete	Total Cost
9999: *Congressional Adds*	-	8.250	-	-	-	-	-	-	-	-	-	8.250

The FY 2015 OCO Request will be submitted at a later date.

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other Projects.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2013	FY 2014
Congressional Add: Adv Radar Innovation Fund - S&T (Cong)	8.250	-
FY 2013 Accomplishments: -Development of a long range radar capability and electronic support measure system for identifying maritime targets. -Ruggedization of back end processing equipment associated with the Affordable Common Radar Architecture system. -Development and flight test a high resolution detector operating over the full radar volume. -Initiate and integrate a high resolution camera to verify maritime target identification.		
FY 2014 Plans: N/A		
Congressional Adds Subtotals	8.250	-

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.