Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Navy	Date: May 2021
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 6: *RDT&E Management Support*	**R-1 Program Element (Number/Name)** PE 0605866N *I Navy Space & Electr Warfare Supt*

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	0.000	12.217	15.695	17.653	-	17.653	-	-	-	-	-	-
0706: *EMC & RF Mgmt*	0.000	2.199	3.163	2.564	-	2.564	-	-	-	-	-	-
3239: *Real-Time Spectrum Operations (RTSO)*	0.000	10.018	12.532	15.089	-	15.089	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

Project 0706, Electromagnetic Compatibility (EMC) and Radio Frequency (RF) Management Program. This project develops tools, processes, EMC Criteria for Navy Systems,and algorithms to identify and mitigate EMI sources for Navy systems and platforms.

Project 3239, The Real-Time Spectrum Operations (RTSO) effort researches and develops software to automate analyses of the Electromagnetic (EM) Environmental Effects (E3) between shipboard transmitters and receivers on ships and the interactions of the EM systems within the other systems installed on units within a strike group. RTSO develops and updates numerical models, algorithms, data bases, and software which aids and supports warfighter spectrum planning, sensing and monitoring characterization and prediction, and managing and maneuvering within the EM spectrum.

B. Program Change Summary ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	12.652	15.787	18.890	-	18.890
Current President's Budget	12.217	15.695	17.653	-	17.653
Total Adjustments	-0.435	-0.092	-1.237	-	-1.237
• Congressional General Reductions	-	-0.092			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.435	0.000			
• Program Adjustments	0.000	0.000	-1.036	-	-1.036
• Rate/Misc Adjustments	0.000	0.000	-0.201	-	-0.201

Change Summary Explanation

FUNDING:

The FY2022 funding request was reduced by $.7 million for Total Force Manpower savings.

Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Navy	Date: May 2021
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 6: *RDT&E Management Support*	**R-1 Program Element (Number/Name)** PE 0605866N *I Navy Space & Electr Warfare Supt*

Project 3239, Real-Time Spectrum Operations (RTSO) (+$2.557M)
- FY21 to FY22 increase is associated with the testing, integration and transition of the RTSO Own Force Monitoring (OFM) Deployable Mission Module (DMM) capability to meet critical Fleet requirements for Emissions Control (EMCON) validation and Tactical Situation (TACSIT) management on all non-capable ships. The RTSO OFM DMM will be developed and fielded to meet validated OFM capability requirements outlined in U.S. Fleet Forces Command / Commander, U.S. Pacific Fleet RTSO Requirements Document Letter dated 4 Dec 2017.

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy			Date: May 2021
Appropriation/Budget Activity 1319 / 6	R-1 Program Element (Number/Name) PE 0605866N / *Navy Space & Electr Warfare Supt*	Project (Number/Name) 0706 / *EMC & RF Mgmt*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
0706: *EMC & RF Mgmt*	0.000	2.199	3.163	2.564	-	2.564	-	-	-	-	-	-
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Electromagnetic Compatibility (EMC) and Radio Frequency (RF) Management Program. This project develops tools, processes, and algorithms to identify and mitigate EMI sources for Navy systems and platforms.

(a) It will support the research, development, testing, and evaluation of electromagnetic compatibility criteria and frequency management to support afloat electromagnetic spectrum operations. The RF EMC criteria will be enhanced to include new RF systems and to comply with fleet operational requirements and streamline Strike Force frequency management processes. It will provide automated Spectrum Management (SM) compatibility criteria for development of operational task communication and radar/weapon plans to support fleet deployments, exercises, and contingency operations. It will provide identification and mitigation of EMI in Navy, North Atlantic Treaty Organization (NATO), Allied, Ashore and Joint Combat Operations. It will provide analysis related to spectrum reallocation proposals to assess impacts on Navy operations and systems, as well as for the Spectrum Supportability Risk Assessments. It will assist numbered fleet commands and DoD commands with determination of EMC criteria and processes to maximize ships' ability to operate in contested and congested environments.

(b) It will support the Shipboard Electromagnetic Compatibility Improvement Program (SEMCIP) to identify, engineer, and evaluate effectiveness of potential EMI corrections. The program also characterizes and quantifies the operational impact of EMI problems on system's mission performance.

(c) It will support the Nuclear Electromagnetic Pulse (EMP) Survivability Program. The program assesses the EMP survivability of all mission critical systems and funds development of a hardness assurance and maintenance program. It will develop improved modeling capability to reduce hardness validation costs at delivery and over the lifetime of the system/platform. The program develops new and updated design criteria, test methodology, test limits, and survivability validation procedures for all Navy systems, ships, submarines and shore facilities.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: RF Management	0.300	0.415	0.404	0.000	0.404
Articles:	-	-	-	-	-
FY 2021 Plans: - Provide engineering analyses and recommendations for updating Littoral Radiation Restrictions for numbered fleet areas of responsibility. Document the worldwide Littoral Radiation Restrictions and provide to the fleet and to RTSO.					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 6	**R-1 Program Element (Number/Name)** PE 0605866N / *Navy Space & Electr Warfare Supt*	**Project (Number/Name)** 0706 / *EMC & RF Mgmt*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Conduct engineering analyses and testing to determine electromagnetic compatibility (EMC) criteria for Navy assets. - Document EMC criteria in NAVSEA Operational Publication S9407-AA-GYD-010/(S) OP-3840 "Electromagnetic Compatibility Criteria for Navy Systems (U)". - Revise and update Standing Operational Tasking (OPTASK) Communications Plans to accommodate Navy equipment and host nation regulations. - Provide impact assessments and analysis for new spectrum-dependent equipment, spectrum policy updates, and changing geopolitical conditions. - Research interactions and leveraging opportunities between various data sources for spectrum data; provide the Navy layer input for joint restricted frequency lists, and equipment, platform, and other databases. - Serve as the Navy's subject matter experts for spectrum de-confliction, EMC, and tactical spectrum management within Navy, DoD, and external components. ***FY 2022 Base Plans:*** - Provide engineering analyses and recommendations for updating Littoral Radiation Restrictions for numbered fleet areas of responsibility. Document the worldwide Littoral Radiation Restrictions and provide to the fleet and to RTSO. - Conduct engineering analyses and testing to determine electromagnetic compatibility (EMC) criteria for Navy assets. - Document EMC criteria in NAVSEA Operational Publication S9407-AA-GYD-010/(S) OP-3840 "Electromagnetic Compatibility Criteria for Navy Systems (U)". - Revise and update Standing Operational Tasking (OPTASK) Communications Plans to accommodate Navy equipment and host nation regulations. - Integrate Navy spectrum management requirements into joint and DoD architectures and processes. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Decrease of $0.011M from FY 21 to FY 22 is due to FY 21 completion of development of EMC criteria for one of the newly fielded radar systems aboard ship.					
Title: Shipboard Electromagnetic Compatibility Improvement Program (SEMCIP)	1.239	1.803	1.225	0.000	1.225
Articles:	-	-	-	-	-
FY 2021 Plans:					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 6	**R-1 Program Element (Number/Name)** PE 0605866N / *Navy Space & Electr Warfare Supt*	**Project (Number/Name)** 0706 / *EMC & RF Mgmt*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Quantify and begin to characterize technical impacts of new Electromagnetic Interference (EMI) problems reported and predicted from FY18 to present. - Analyze and evaluate effectiveness of radar signal processing algorithms for the mitigation of current and future electromagnetic environment waveforms. - Analyze and evaluate effectiveness of forward error correction algorithms for the mitigation of current and future electromagnetic environment waveforms. - Continue to develop new EMI fixes and evaluate their effectiveness in mitigating shipboard EMI. - Continue evaluation of Unmanned Bit Error Rate Test (UBERT) capability and research applicability on legacy, EBEM SATCOM modem to Ship EMC Certification. - Develop Unmanned Bit Error Rate Test (UBERT) capability for adaptive, shipboard EBEM replacement modem. - Develop autonomous EMI detection capabilities for radar and communication systems in order to reduce test time and quantify likelihood over extended periods, like ship underway periods or operational deployments. - Develop high frequency (HF) intermodulation (IMI) test methods and standards, and develop alternate test methods applicable to digital HF receivers.					
FY 2022 Base Plans: - Continue characterization of technical impacts of new, high priority shipboard Electromagnetic Interference (EMI) problems reported and predicted from to date. - Develop new EMI fixes and evaluate their effectiveness in mitigating shipboard EMI. - Implement Unmanned Bit Error Rate Test (UBERT) capability into Ship EMC Certification to characterize EMI impacts on SATCOM links. - Evaluate Unmanned Bit Error Rate Test (UBERT) capability for adaptive, shipboard EBEM replacement modem. - Evaluate and improve autonomous EMI detection capabilities for radar and communication systems in order to reduce test time and quantify likelihood over extended periods, like ship underway periods or operational deployments. - Continue development and implementation of high frequency (HF) intermodulation (IMI) test methods and standards, and alternate test methods applicable to digital HF receivers.					
FY 2022 OCO Plans: N/A					
FY 2021 to FY 2022 Increase/Decrease Statement:					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 6	**R-1 Program Element (Number/Name)** PE 0605866N / *Navy Space & Electr Warfare Supt*	**Project (Number/Name)** 0706 / *EMC & RF Mgmt*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
FY21 - FY22 decrease provides less engineering hours supporting core capability to achieve electromagnetic compatibility (EMC) by effective prevention, identification, characterization, resolution, and control of electromagnetic interference (EMI) impacting U.S. Naval surface ships, submarines, ashore commands, and strike groups in joint and littoral operations.					
Title: Electromagnetic Pulse (EMP) Survivability	0.660	0.945	0.935	0.000	0.935
Articles:	-	-	-	-	-
FY 2021 Plans: - Complete computational electromagnetic (CEM) modeling capability to assist in ship hardness design. - Continue developing new Hybrid-Based High Altitude Electrometric Pulse (HEMP) evaluation technique to evaluate HEMP hardness of navy ships via a low-cost, low potential for equipment damage and quicker method of analysis (decreasing costs in the performance of tests). - Continue investigating small, inexpensive measurement devices for incorporation into Hybrid-Based HEMP evaluation methodology. - Finish developing instrumentation and data acquisition capability in support of the HEMP Ashore Test Facility [i.e., Naval Ordinance Transient Electromagnetic Simulator]. - Refine design criteria, test methodology, test limits, and survivability validation procedures for Navy systems, ships, submarines and shore facilities. - Perform research and development of integrated solutions for EMP hardening. Investigate improvements to the cable shield ground adapters, terminal protection devices and cable maintenance procedures.					
FY 2022 Base Plans: - Continue developing new Hybrid-Based High Altitude Electrometric Pulse (HEMP) evaluation technique to evaluate HEMP hardness of navy ships via a low-cost, low potential for equipment damage and quicker method of analysis (decreasing costs in the performance of tests). - Continue investigating small, inexpensive measurement devices for incorporation into Hybrid-Based HEMP evaluation methodology. - Investigate Cable Shield Transfer Impedance for evaluating shipboard cables in-situ. - Refine research and development of integrated solutions for EMP hardening. - Complete Cooperative Research And Development Agreement (CRADA) for concepts to repair cable shield ground adapters in-situ, terminal protection devices and cable maintenance procedures.					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 6	**R-1 Program Element (Number/Name)** PE 0605866N / *Navy Space & Electr Warfare Supt*	**Project (Number/Name)** 0706 / *EMC & RF Mgmt*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Initialize validation of computational electromagnetic (CEM) modeling capability to assist in ship hardness design. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Minimal decrease from FY21 - FY22 of -0.01 is due to reduced costs associated with developing data acquisition capability.					
Accomplishments/Planned Programs Subtotals	2.199	3.163	2.564	0.000	2.564

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy			Date: May 2021
Appropriation/Budget Activity 1319 / 6	R-1 Program Element (Number/Name) PE 0605866N / *Navy Space & Electr Warfare Supt*	Project (Number/Name) 3239 / *Real-Time Spectrum Operations (RTSO)*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
3239: *Real-Time Spectrum Operations (RTSO)*	0.000	10.018	12.532	15.089	-	15.089	-	-	-	-	-	-
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Real-Time Spectrum Operations (RTSO) develops tools, processes, and algorithms to conduct spectrum planning, sense and monitor, characterize and predict Electromagnetic Environmental Effects(E3), and manage and maneuver to avoid and mitigate Electromagnetic Interference (EMI) and Electromagnetic (EM) Vulnerability for Navy systems and platforms.

RTSO supports Navy and Marine Corps Electromagnetic Spectrum Operations for global spectrum usage and allocation planning. The effort researches the EM E3 between shipboard transmitters and receivers on ships and the interactions of the EM systems within the other systems installed on units within a strike group. RTSO will develop a capability to sense and monitor shipboard EM Spectrum Usage and validate the spectrum plan to achieve Emissions Control (EMCON) within the strike group. The effort will validate and display spectrum plan compliance with a spectrum common operational picture. This EM spectrum Management Aid with own force monitoring sensor input supports Battlespace Awareness and Information Operations. These self-awareness and validation capabilities will greatly enhance the Navy's ability to perform Command and Control of the EM Spectrum warfighting domain.

FY 2022 will focus on the testing, integration and transition of the RTSO Own Force Monitoring (OFM) Deployable Mission Module (DMM) capability to meet critical Fleet requirements for Emissions Control (EMCON) validation and Tactical Situation (TACSIT) management on all non-capable ships.

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Title: Real-Time Spectrum Operations (RTSO)	10.018	12.532	15.089	0.000	15.089
Articles:	-	-	-	-	-
FY 2021 Plans: - Continue to research, develop, enhance and refine Cloud architecture, Spectrum Common Operational Picture (COP), Live data, Detect, counter-detect (1-to-1), Time slide, and Network nodes. - Continue research, development, testing, and evaluation for own-force spectrum monitoring capabilities, including new commercial and military sensors, antenna, and network connections. - Continue research and development of proof-of-concept capabilities for spectrum mission planning decision aids and intelligent sectoring/cut-outs for radiating systems					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 6	**R-1 Program Element (Number/Name)** PE 0605866N / *Navy Space & Electr Warfare Supt*	**Project (Number/Name)** 3239 / *Real-Time Spectrum Operations (RTSO)*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Continue research and development efforts for models to estimate effective RF performance ranges of spectrum dependent systems in the complex electromagnetic environment (one-on-one and multi-on-one effects) - Continue to refine analysis with Ship Signal Exploitation Equipment (SSEE) Family of Systems (FoS) Programs of Records to identify long-term hardware solution set for deployment for SSEE enabled platforms as well as non-SSEE enabled platforms. - Continue research on RTSO support on Tactical Airborne and Submarine platforms. - Continue Limited Objective Experiments (LOEs) to demonstrate incremental capability to Fleet users. - Continue development of an architecture that supports mission module delivery of RTSO capability on all platforms					
FY 2022 Base Plans: - FY22 increase is associated with testing, integration and transition efforts in advance of deployment of the RTSO Own Force Monitoring (OFM) Deployable Mission Module (DMM) capability to meet critical Fleet requirements for Emissions Control (EMCON) validation and Tactical Situation (TACSIT) management on all non-capable ships. The RTSO OFM DMM will be developed and fielded to meet validated OFM capability requirements outlined in U.S. Fleet Forces Command / Commander, U.S. Pacific Fleet RTSO Requirements Document Letter dated 4 Dec 2017. - Continue to research, develop, enhance and refine Cloud architecture, Spectrum Common Operational Picture (COP), Live data, Detect, counter-detect (1-to-1), Time slide, and Network nodes. - Continue research, development, testing, and evaluation for own-force spectrum monitoring capabilities, including commercial and military sensors, antenna, and network connections. - Continue research and development of proof-of-concept capabilities for spectrum mission planning decision aids and intelligent sectoring/cut-outs for radiating systems. - Continue research and development efforts for models to estimate effective Radio Frequency (RF) performance ranges of spectrum dependent systems in the complex electromagnetic environment (one-on-one and multi-on-one effects). - Continue to refine analysis with SSEE Family of Systems Programs of Record to identify long-term hardware solution set for deployment on SSEE enabled platforms as well as non-SSEE enabled platforms. - Finalize testing, integration and transition efforts in advance of deployment of the RTSO Own Force Monitoring (OFM) Deployable Mission Module (DMM) capability to meet critical Fleet requirements for Emissions Control (EMCON) validation and Tactical Situation (TACSIT) management on all non-capable ships. - Continue LOEs to demonstrate incremental capability to Fleet users.					

Exhibit R-2A, RDT&E Project Justification: PB 2022 Navy		Date: May 2021
Appropriation/Budget Activity 1319 / 6	**R-1 Program Element (Number/Name)** PE 0605866N / *Navy Space & Electr Warfare Supt*	**Project (Number/Name)** 3239 / *Real-Time Spectrum Operations (RTSO)*

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
- Continue development of an architecture that supports mission module delivery of RTSO capability on all platforms. - Investigate external data sources from other Navy Programs of Record to provide improved EM spectrum awareness. ***FY 2022 OCO Plans:*** N/A ***FY 2021 to FY 2022 Increase/Decrease Statement:*** - FY22 increase is associated with testing, integration and transition efforts in advance of deployment of the RTSO Own Force Monitoring (OFM) Deployable Mission Module (DMM) capability to meet critical Fleet requirements for Emissions Control (EMCON) validation and Tactical Situation (TACSIT) management on all non-capable ships. The RTSO OFM DMM will be developed and fielded to meet validated OFM capability requirements outlined in U.S. Fleet Forces Command / Commander, U.S. Pacific Fleet RTSO Requirements Document Letter dated 4 Dec 2017.					
Accomplishments/Planned Programs Subtotals	10.018	12.532	15.089	0.000	15.089

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A