Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy	Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	0.000	15.127	17.653	27.175	-	27.175	27.650	27.677	26.944	27.234	Continuing	Continuing
0706: *EMC & RF Mgmt*	0.000	3.080	2.564	2.584	-	2.584	2.622	2.564	2.590	2.626	Continuing	Continuing
3239: *Real-Time Spectrum Operations (RTSO)*	0.000	12.047	15.089	24.591	-	24.591	25.028	25.113	24.354	24.608	Continuing	Continuing

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 Electromagnetic Interference (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 aiding and supporting warfighter spectrum planning, sensing and monitoring of the EM environment, EM spectrum characterization and prediction, and managing and maneuvering within the EM spectrum.

B. Program Change Summary ($ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	15.695	17.653	0.000	-	0.000
Current President's Budget	15.127	17.653	27.175	-	27.175
Total Adjustments	-0.568	0.000	27.175	-	27.175
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.020	0.000			
• SBIR/STTR Transfer	-0.548	0.000			
• Program Adjustments	0.000	0.000	0.000	-	0.000
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	27.175	-	27.175

Change Summary Explanation

FUNDING:

Project 3239, Real-Time Spectrum Operations (RTSO) ($9.502M)

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Navy	Date: April 2022
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*

- FY2022 to FY2023 increase of $9,522K will develop, test, and integrate a permanent solution to meet Spectral Warrior capability requirements. Funds will also allow integration efforts to deploy Own Force Monitoring (OFM) capability to non-Ship's Signal Exploitation Equipment (SSEE) platforms.

FY 2023 funding increase reflects the fact that the FY 2022 President’s Budget request did not include out-year funding.

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
0706: *EMC & RF Mgmt*	0.000	3.080	2.564	2.584	-	2.584	2.622	2.564	2.590	2.626	Continuing	Continuing
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 Electromagnetic Interference (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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: RF Management	0.415	0.404	0.385	0.000	0.385
Articles:	-	-	-	-	-
FY 2022 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 Real-Time Spectrum Operations (RTSO).					

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Conduct engineering analyses and testing to determine electromagnetic compatibility (EMC) criteria for Navy assets, to include AN/SPY-3 and AN/SPY-4. - Document EMC criteria in NAVSEA Operational Publication S9407-AA-GYE-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. - Serve as the Navy's subject matter experts for spectrum de-confliction, electromagnetic compatibility (EMC), and tactical spectrum management within Navy, DoD, and external components. - Represent Navy tactical spectrum management requirements in various working groups and venues, including Electromagnetic Battle Management (EMBM), electromagnetic maneuver warfare (EMW), and electromagnetic spectrum operations (EMSO) efforts. Integrate Navy spectrum management requirements into joint and DoD enterprise architectures and processes.					
FY 2023 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 Real-Time Spectrum Operations (RTSO). - Conduct engineering analyses and testing to determine EMC criteria for Navy assets, such as AN/SPN-50. - Document EMC criteria in NAVSEA Operational Publication S9407-AA-GYE-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. - Serve as the Navy's subject matter experts for spectrum de-confliction, EMC, and tactical spectrum management within Navy, DoD, and external components. - Represent Navy tactical spectrum management requirements in various working groups and venues, including Electromagnetic Battle Management (EMBM), electromagnetic maneuver warfare (EMW), and electromagnetic spectrum					

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
operations (EMSO) efforts. Integrate Navy spectrum management requirements into joint and DoD enterprise architectures and processes. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** 0.019 million decrease due to scheduled completion of Electromagnetic Compatibility (EMC) criteria development, testing, and evaluation for AN/SPN-50 in FY 23.					
Title: Shipboard Electromagnetic Compatibility Improvement Program (SEMCIP)	1.720	1.233	1.245	0.000	1.245
Articles:	-	-	-	-	-
FY 2022 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. - Continue to analyze and evaluate effectiveness of radar signal processing algorithms for the mitigation of current and future electromagnetic environment waveforms. - Continue to analyze and evaluate effectiveness of forward error correction algorithms for the mitigation of current and future electromagnetic environment waveforms. - 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 2023 Base Plans:*** - Continue characterization of technical impacts of new, high priority shipboard EMI problems reported and predicted from to date.					

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- 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 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** .012 million increase provides 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 and strike groups in joint and littoral operations.					
Title: Electromagnetic Pulse (EMP) Survivability	0.945	0.927	0.954	0.000	0.954
Articles:	-	-	-	-	-
FY 2022 Plans: - Continue to research and development of 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. - Continue Investigation Cable Shield Transfer Impedance for evaluating shipboard cables in-situ. - Complete development of cable shield ground adaptors for 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 2023 Navy		Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Continue validating computational electromagnetic (CEM) modeling capability to assist in ship hardness design. - Research, development and definition of data acquisition system for ship HEMP health demonstration ***FY 2023 Base Plans:*** - Continue research, development and refinement of 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 research, development and investigation of small, inexpensive measurement devices for incorporation into Hybrid-Based HEMP evaluation methodology. - Validate Cable Shield Transfer Impedance in-situ testing for evaluating shipboard cables. - Investigate Parametric Cable measurement techniques. - Investigate usage of magneto-optic media High Altitude Electrometric Pulse (HEMP)-Induced Current Sensors to observe magnetic-field onboard ships using swept continuous wave testing. - Research and develop integration of Continuous Wave Antenna into EXpanded EMP Test - Capabilities (EXEMPT C) effort for ship High Altitude Electrometric Pulse (HEMP) health testing and demonstration. - Integrate Digital Data re-construction of magnetic tapes to computer format from the early 1990's Electromagnetic Pulse Radio Frequency (RF) Environment Simulator for Ships (EMPRESS) II into the validation of Computational Electromagnetics modeling. ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** 0.027 million increase due development of ship HEMP health demonstration planned for out-year.					
Accomplishments/Planned Programs Subtotals	3.080	2.564	2.584	0.000	2.584

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3239: *Real-Time Spectrum Operations (RTSO)*	0.000	12.047	15.089	24.591	-	24.591	25.028	25.113	24.354	24.608	Continuing	Continuing
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 (EM) environmental effects (E3), and manage and maneuver to avoid and mitigate electromagnetic interference (EMI) and 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 effects 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 developed 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 validates and displays spectrum plan compliance with a spectrum common operational picture. This EM spectrum management aid with an 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 2023 will develop, test and integrate Spectral Warrior capability replacements and begin to deploy Own Force Monitoring (OFM) capability to non- Ship's Signal Exploitation Equipment (SSEE) platforms. (Details held at a higher classification)

B. Accomplishments/Planned Programs ($ in Millions, Article Quantities in Each)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Real-Time Spectrum Operations (RTSO)	12.047	15.089	24.591	0.000	24.591
Articles:	-	-	-	-	-
FY 2022 Plans: - Continue 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.					

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- 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 Ship's Signal Exploitation Equipment (SSEE) Family of Systems (FoS) 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 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. - Investigate external data sources from other Navy Programs of Record to provide improved Electromagnetic (EM) spectrum awareness.					
FY 2023 Base Plans: - Begin to develop a permanent solution to Spectral Warrior capability replacements and integration efforts to deploy Own Force Monitoring (OFM) capability to non- Ship's Signal Exploitation Equipment (SSEE) platforms. (Details held at a higher classification) - Begin to test, integrate, and transition Ship's Signal Exploitation Equipment (SSEE) Own Force Monitoring (OFM) capability to non-SSEE platforms. Fielding designs meet critical Fleet requirements for Emissions Control (EMCON) validation and Tactical Situation (TACSIT) management on all non-Ship's Signal Exploitation Equipment (SSEE) capable ships, to meet validated Own Force Monitoring (OFM) capability requirements outlined in U.S. Fleet Forces Command / Commander, U.S. Pacific Fleet RTSO Requirements.					

Exhibit R-2A, RDT&E Project Justification: PB 2023 Navy		Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
- Continue transition efforts for an OFM capability integrated with SSEE systems. Fielding designs meet critical Fleet requirements for Emissions Control (EMCON) validation and TACSIT management on all non-capable ships, to meet validated OFM capability requirements outlined in U.S. Fleet Forces Command / Commander, U.S. Pacific Fleet RTSO Requirements. - 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 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 RF performance ranges of spectrum dependent systems in the complex electromagnetic environment (one-on-one and multi-on-one effects) - Continue to participate in LOEs to demonstrate incremental capability to Fleet users - Continue development of an architecture supporting mission module delivery of RTSO capability on all platforms - Finalize RTSO v2.0 release to ashore and afloat Fleet users in a cloud environment ***FY 2023 OCO Plans:*** N/A ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY2022 to FY2023 increase of $9.502 million will develop, test, and integrate a permanent solution to meet Spectral Warrior requirements. Funds will also allow integration efforts to deploy Own Force Monitoring (OFM) capability to non-Ship's Signal Exploitation Equipment (SSEE) platforms. (Details held at a higher classification)					
Accomplishments/Planned Programs Subtotals	12.047	15.089	24.591	0.000	24.591

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A