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

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603271N / <i>Electromagnetic Systems Advanced Technology</i>
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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	22.267	12.146	8.253	-	8.253	8.418	8.587	8.758	8.933	Continuing	Continuing
2913: <i>Electromagnetic Systems Advanced Technology</i>	0.000	7.786	8.146	8.253	-	8.253	8.418	8.587	8.758	8.933	Continuing	Continuing
9999: <i>Congressional Adds</i>	0.000	14.481	4.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	18.481

A. Mission Description and Budget Item Justification

The Navy and Marine Corps' sophisticated electronics systems place heavy demands on the electromagnetic spectrum to accommodate information flow, defensive and offensive detection, tracking, and weapon system engagement. In distributed maritime operations, each of these platforms provides a set of capabilities that can be further combined for progressively larger and more complex operations. The Electromagnetic Systems Advanced Technology program addresses 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. 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, EW, and Communications and Network functions across platforms through multiple, simultaneous and continuous communications/data links.

Today's Sailors and Marines are enabled by Naval Science and Technology (S&T). Since 1946, the Office of Naval Research (ONR) has fostered scientific research related to the maintenance of maritime superiority and national defense. ONR manages the Department of the Navy's (DON) portfolio of naval Basic and Applied research, and Advanced Technology Development investments to ensure naval forces can effectively deter conflict, but when called upon, fight, win and come home safe. Current investments hedge against uncertainty, providing solutions to commanders today, and options for the future. The Naval S&T budget supports higher guidance defined by the National Defense Strategy, and responds to requirements identified by the Secretary of the Navy through research priorities set by the Chief of Naval Research, coordinated across the Naval Research Enterprise (NRE), and outlined in the Naval R&D Framework.

This Program Element (PE) funds Advanced Technology Development (ATD) that includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment. Efforts in this PE generally have Technology Readiness Levels (TRL) of 4 (component and/or breadboard validation in laboratory environment.), 5 (component and/or breadboard validation in relevant environment.), or 6 (system/subsystem model or prototype demonstration in a relevant environment).

Due to the number of efforts in this PE, the programs described herein are representative of the work included in this PE.

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B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	22.957	8.146	0.000	-	0.000
Current President's Budget	22.267	12.146	8.253	-	8.253
Total Adjustments	-0.690	4.000	8.253	-	8.253
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	4.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.690	0.000			
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000
• Adjustments to Budget Year	-	-	8.253	-	8.253

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: 9999: *Congressional Adds*

Congressional Add: *All Digital Radar Technology*

Congressional Add: *Advanced machine learning and artificial intelligence*

Congressional Add Subtotals for Project: 9999

Congressional Add Totals for all Projects

	FY 2021	FY 2022
	14.481	0.000
	0.000	4.000
Congressional Add Subtotals for Project: 9999	14.481	4.000
Congressional Add Totals for all Projects	14.481	4.000

Change Summary Explanation

funding: No significant change.

Technical: No significant change.

Schedule: No significant change.

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

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Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603271N / <i>Electromagnetic Systems Advanced Technology</i>				Project (Number/Name) 2913 / <i>Electromagnetic Systems Advanced Technology</i>			
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
2913: <i>Electromagnetic Systems Advanced Technology</i>	0.000	7.786	8.146	8.253	-	8.253	8.418	8.587	8.758	8.933	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

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, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Electronic and Electromagnetic Systems	4.065	4.252	4.307	0.000	4.307
Articles:	-	-	-	-	-
<p>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 Program Element (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. Technology development is focused on Distributed Electronic Warfare in support of Distributed Maritime Operations.</p> <p>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.</p> <p>FY 2022 Plans: Advanced Electronic Warfare Enabling Technologies: - Continue research in the areas of Electronic Support (ES); decoys and countermeasures against weapon tracking and guidance systems; Electronic Attack (EA) against adversary Command, Control, Communications, Computers, Cyber Defense, Intelligence, Surveillance, Reconnaissance and Targeting (C5ISR). - Continue development of Electronic Protection (EP) for our own weapons and C5ISR from intentional and unintentional interference. - Continue analysis of results of FY21 test and evaluation activities, leading to refinement and modification of designs based on results.</p>					

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<p>- Initiate implementation of modified and additional Electronic Warfare (EW) capabilities.</p> <p>FY 2023 Base Plans: Advanced Electronic Warfare Enabling Technologies: - Continue research in the areas of Electronic Support (ES); decoys and countermeasures against weapon tracking and guidance systems; Electronic Attack (EA) against adversary Command, Control, Communications, Computers, Cyber Defense, Intelligence, Surveillance, Reconnaissance and Targeting (C5ISRT). - Continue development of Electronic Protection (EP) for our own weapons and C5ISRT from intentional and unintentional interference. - Continue efforts based on analysis of results of FY21 test and evaluation activities. Informed by this now completed analyses of results of test and evaluation activities in FY21 and other years, initiate refinement of EW concepts, techniques and designs. Examine the improved and novel approaches regularly based on available analytical products, and update as required. - Continue implementation of modified and additional Electronic Warfare (EW) capabilities, and initiate the use of Live, Virtual, and Constructive (LVC) methods for technology identification and exploration, including concepts of employment and training.</p> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</p>					
<p>Title: Global Positioning System (GPS) and Navigation Technology</p> <p align="right">Articles:</p> <p>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 non-Global Positioning System (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).</p> <p>FY 2022 Plans: Position, Navigation and Timing (PNT): - Continue research on miniature fiber optic inertial capability to improve non-GPS navigation.</p>	3.721	3.894	3.946	0.000	3.946
	-	-	-	-	-

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
<ul style="list-style-type: none"> - Continue research on waveforms for precision two-way time transfer techniques to mitigate GPS electronic threats. - Continue research into mounted alternative navigation systems for USMC specific platforms to improve operational effectiveness. - Continue research into Low Earth Orbit constellation receivers for naval platforms to improve operational effectiveness. - Initiate/Complete research on atom-interferometry-based gyroscope. - Initiate the development of components and systems to support alternative Position, Navigation and Timing (PNT) solutions, e.g., Optical Doppler Velocity Log and Micro-Electromechanical Systems based gyroscopes. <p>FY 2023 Base Plans: Position, Navigation and Timing (PNT):</p> <ul style="list-style-type: none"> - Continue research on waveforms for precision two-way time transfer techniques to mitigate GPS electronic threats. - Continue research into mounted alternative navigation systems for USMC specific platforms to improve operational effectiveness. - Continue research into Low Earth Orbit constellation receivers for naval platforms to improve operational effectiveness. - Continue the development of components and systems to support alternative PNT solutions, e.g., Optical Doppler Velocity Log and Micro-Electromechanical Systems based gyroscopes. - Complete research on miniature fiber optic inertial capability to improve non-Global Positioning System (GPS) navigation. <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: There is no significant funding change from FY 2022 to FY 2023.</p>					
Accomplishments/Planned Programs Subtotals	7.786	8.146	8.253	0.000	8.253

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

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D. Acquisition Strategy
N/A

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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
9999: <i>Congressional Adds</i>	0.000	14.481	4.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	18.481
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Navy and Marine Corps' sophisticated electronics systems must continually be updated to accommodate increasing information flow, harsh electromagnetic operating conditions, defensive/offensive detection, tracking, and weapon system engagement needs. All Digital Radar Technology, already the core technology to an Air Force advanced threat emulator program, may be fully leveraged via the Electromagnetic Systems Advanced Technology Program to meet additional near term Department of Navy operational needs. With the requested funding, the Office of Naval Research will conduct an All Digital Radar Technology Advanced Technology Demonstration (ATD) and evaluation. The project will expand utilization beyond current advanced threat simulator applications, construct a U.S. prototype demo and evaluation and when appropriate, facilitate technology transfer to the United States..

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2021	FY 2022
<i>Congressional Add:</i> All Digital Radar Technology	14.481	0.000
<i>FY 2021 Accomplishments:</i> Conducted research supporting All Digital Radar Technology. Planned FY21 activities include contract award and kickoff meeting.		
<i>FY 2022 Plans:</i> N/A		
<i>Congressional Add:</i> Advanced machine learning and artificial intelligence	0.000	4.000
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct advanced machine learning and artificial intelligence technology development		
Congressional Adds Subtotals	14.481	4.000

C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A