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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Navy **Date:** March 2023

Appropriation/Budget Activity 1319: <i>Research, Development, Test & Evaluation, Navy / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603673N / <i>Future Naval Capabilities Advanced Tech Dev</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	0.000	275.441	268.993	264.700	-	264.700	272.130	277.739	269.493	275.934	Continuing	Continuing
3346: <i>Future Naval Capabilities Adv Tech Dev</i>	0.000	248.411	250.993	264.700	-	264.700	272.130	277.739	269.493	275.934	Continuing	Continuing
9999: <i>Congressional Adds</i>	0.000	27.030	18.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	45.030

A. Mission Description and Budget Item Justification

The Office of Naval Research (ONR) was established to ensure the technological advantage of U.S. Naval forces. ONR manages the Department of the Navy's science and technology (S&T) research portfolio (Basic, Applied and Advanced Technology Development investments). This work includes the Future Naval Capabilities (FNC) program, which delivers technology solutions to known requirements and accelerates innovative technology insertion into Programs of Record (PORs). In close and structured coordination with POR Stakeholders (Combat Capability Development organizations, Operating Forces, and acquisition organizations), FNC efforts create revolutionary technology for PORs. ONR's S&T competencies create substantially higher levels of technology, trade space, and capability gain than acquisition can create within POR programmatic risk constraints. FNC projects create exponential technology improvement substantially cheaper than POR vendors do. The structured FNC process and its specific transition mechanisms manage technical risk and increase the likelihood that technologies systematically deploy to warfighters.

The efforts described in this Program Element (PE) 0603673N for FNC Advanced Technology Development use earlier research conducted in PE 0602750N for FNC Applied Research., and have follow-on transition funding commitments in the receiving acquisition Program of Record PEs. Using a competitive selection process, ONR and POR Stakeholders assess and select each effort in this PE based on its revolutionary technology payoff to the naval warfighter and prioritized operating force requirements. FNC requests from POR Stakeholders exceed funding available in the FNC Program and drive the competitive selection.

Due to the classified efforts in this PE, some have incomplete descriptions. ONR can provide additional information in classified documents.

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B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	282.020	251.267	264.700	-	264.700
Current President's Budget	275.441	268.993	264.700	-	264.700
Total Adjustments	-6.579	17.726	0.000	-	0.000
• Congressional General Reductions	-	-0.274			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	18.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-6.579	0.000			
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000

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

Project: 9999: *Congressional Adds*

Congressional Add: *Advanced Energetics Research*

Congressional Add: *Development of Submersible Air Revitalization*

Congressional Add: *Advanced lidar sensor and data processing*

Congressional Add: *Electronic maneuver warfare unmanned sensors*

Congressional Add: *Advance machine learning and artificial intelligence*

Congressional Add: *Advanced carbon nanotube conductors for naval power systems*

Congressional Add Subtotals for Project: 9999

Congressional Add Totals for all Projects

	FY 2022	FY 2023
Congressional Add: <i>Advanced Energetics Research</i>	2.896	5.000
Congressional Add: <i>Development of Submersible Air Revitalization</i>	0.000	8.000
Congressional Add: <i>Advanced lidar sensor and data processing</i>	1.931	0.000
Congressional Add: <i>Electronic maneuver warfare unmanned sensors</i>	13.515	0.000
Congressional Add: <i>Advance machine learning and artificial intelligence</i>	8.688	0.000
Congressional Add: <i>Advanced carbon nanotube conductors for naval power systems</i>	0.000	5.000
Congressional Add Subtotals for Project: 9999	27.030	18.000
Congressional Add Totals for all Projects	27.030	18.000

Change Summary Explanation

Funding: No significant change.

Technical: No significant change.

Schedule: No significant change.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Navy										Date: March 2023		
Appropriation/Budget Activity 1319 / 3					R-1 Program Element (Number/Name) PE 0603673N / <i>Future Naval Capabilities Advanced Tech Dev</i>				Project (Number/Name) 3346 / <i>Future Naval Capabilities Adv Tech Dev</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
3346: <i>Future Naval Capabilities Adv Tech Dev</i>	0.000	248.411	250.993	264.700	-	264.700	272.130	277.739	269.493	275.934	Continuing	Continuing
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Future Naval Capabilities (FNC) Program exploits technology advances and responds quickly to Naval needs. As a result, future Budget Activity (BA) 3 investments supporting the FNC Program are made less than one year before commencing execution. Because FNCs start at higher Technology Readiness Levels (TRL), the typical duration of an FNC is 3-years. The FNC Program favors a high level of collaboration. Program Element R-2 Activities align to warfare areas where the FNC technologies will be integrated into acquisition programs of record.

A complete accounting of FNC technologies and a full disposition of each technology development effort is provided annually to the Congressional oversight committees.

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

	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Title: Capable Manpower (CMP)	0.000	2.997	5.165	0.000	5.165
Articles:	-	-	-	-	-
<p>Description: The Capable Manpower R-2 Activity focuses on the advanced technology development of new capabilities that leverage the underlying applied research investments in Program Element (PE) 0602750N Future Naval Capabilities (FNC) Applied Research. These advanced technology investments align to acquisition programs of record. Efforts focus on all aspects of training, including accelerated learning, training environments, ready relevant training, and Live-Virtual-Constructive (LVC) training.</p> <p>FY 2023 Plans: My Navy Foresight (MNF) - Initiate development of a web-based model that describes how changes in manpower, personnel, or training influence quantitative (e.g., retention targets) and qualitative (e.g., process improvements) outcomes. These will result in courses of action to make decision support faster and more precise than current processes. - Survey existing models for common and unique data and metadata, link to OPNAV N1's authoritative data environment and user interface, and develop modelling solutions.</p> <p>FY 2024 Base Plans: My Navy Foresight (MNF)</p>					

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<p>- Continue the My Navy Foresight (MNF) FNC by continuing development of the platform decision support system with different Manpower, Personnel, Training and Education (MPTE) data sources. The system will include software that supports Government users' activities.</p> <p>- Continue development of the system models and associated documentation. The models will provide realistic quantitative simulation of MPTE behavior.</p> <p>- Continue identifying and documenting requirements for the development of the software for MNF.</p> <p>FY 2024 OCO Plans: N/A</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: The increase from FY 2023 to FY 2024 is due to the planned ramp-up of the My Navy Foresight (MNF) FNC, which was initiated in FY 2023.</p>					
<p>Title: Expeditionary Maneuver Warfare (EMW)</p> <p align="right">Articles:</p> <p>Description: The Expeditionary Maneuver Warfare R-2 Activity focuses on the advanced technology development of new capabilities that leverage the underlying applied research investments in PE 0602750N, Future Naval Capabilities (FNC) Applied Research. These advanced technology investments align to acquisition programs of record. The advanced technologies being developed under this R-2 Activity include innovative naval mine, mine counter measures (MCM), mine delivery methods, low observable mine neutralization technologies, and other technologies supporting expeditionary maneuver warfare overall.</p> <p>FY 2023 Plans: Magnetic & Acoustic Generation Next Unmanned Superconducting Sweep (MAGNUSS):</p> <p>- Continue progress on the MAGNUSS advanced development model with: fabrication of the superconducting magnet and cryogenic cooling system, sub-scale Seneca Lake testing of the acoustic generator, and integration of the magnetic and acoustic payloads with a single command and control system interface to the MCM-USV or any craft of opportunity.</p> <p>Low Observable No Collateral Damage - Neutralization (LONCD-N) System:</p> <p>- Complete final demonstrations and sea testing for this FNC, which experienced execution delays in FY22 and needed to be extended into FY23 to finish.</p>	37.773	27.185	25.842	0.000	25.842
	-	-	-	-	-

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<p>Compact Encapsulated Mine (C-ENCAP):</p> <ul style="list-style-type: none"> - Compete design and prototype development for modular payload subcomponent integration, to include energetics characterization. Compete optimized deployment for minefield planning capability. <p>Cognitive Router (CR):</p> <ul style="list-style-type: none"> - Initiate development of the Cognitive Router, which is a clandestine AI-enabled, autonomous, undersea, low-latency cross-domain network. - Initiate development of an Artificial Intelligence / Machine Learning (AI/ML)-based cognitive engine for autonomous in-situ decision making for network discovery, link parameters optimization, link path optimization and supporting Autonomous behaviors for cooperative Unmanned Undersea Vehicle (UUV) autonomy (data exfiltration, path planning, obstacle and threat avoidance, and networking). <p>FY 2024 Base Plans:</p> <p>Cognitive Router (CR)</p> <ul style="list-style-type: none"> - Continue the Cognitive Router FNC by continuing development of an Artificial Intelligence / Machine Learning (AI/ML based cognitive engine for autonomous in-situ decision making for network discovery, link parameters optimization, and link path optimization. Demonstrate an increment of autonomous behaviors for cooperative Unmanned Undersea Vehicle (UUV) autonomy with focus on objective arbitration and threat avoidance. - Continue development of data exfiltration, path planning, additional obstacle and threat avoidance, and networking. - Continue development of the Cognitive Router, which is a clandestine AI-enabled, autonomous, undersea, low-latency cross-domain network. Demonstrate Gen1 Cognitive Router AI control and link management in a water data collection event. <p>Magnetic & Acoustic Generation Next Unmanned Superconducting Sweep (MAGNUSS)</p> <ul style="list-style-type: none"> - Continue the MAGNUSS FNC by continuing the advanced development model with adjustments to the integrated magnetic/acoustic payload and any hardware/software mitigations necessary to operate craft in a magnetic field. <p>Long-Range Over the Horizon (OTH) Communications at High Frequency (HF) Using a Nested, Electronically-Steered System (LOCH NESS)</p> <ul style="list-style-type: none"> - Initiate HF multifunction architecture development for greater resiliency. Commence waveform design and beam forming/nulling with advanced algorithms and M&S validation. 					

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<p>- Conduct design review with stakeholders and begin prototype development with pacing demonstration of capabilities.</p> <p>Next Generation High Frequency (NGHF)</p> <p>- Initiate award to industry to develop new signal processing algorithms for advanced long range radar waveforms for improved performance in complex, high-clutter environments.</p> <p>- Implement initial versions of radar signal processing algorithms in a modeling and simulation environment to characterize search, track, and identification capabilities against representative targets.</p> <p>FY 2024 OCO Plans: N/A</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: The decrease from FY 2023 to FY 2024 is predominantly due to the completion in FY23 of two FNCs: Low Observable No Collateral Damage - Neutralization (LONCD-N) System and Compact-Encapsulated Mine (C-ENCAP).</p>					
<p>Title: Air Warfare (AW)</p> <p align="right">Articles:</p> <p>Description: The Air Warfare R-2 Activity focuses on the advanced technology development of new capabilities that leverage the underlying applied research investments in Program Element (PE) 0602750N, Future Naval Capabilities (FNC) Applied Research. These advanced technology investments align to acquisition programs of record. Efforts include human machine interfaces for unmanned platforms and payloads that will assist with delegation of resources from one operator to another, airframe corrosion protection, and a Carrier Air Wing performance assessment tool that uses live, virtual, and constructive data to improve pilot and aircrew performance in near real-time. Different software efforts address unique and specific requirements.</p> <p>FY 2023 Plans: Incapacitation Prediction in Readiness Domains: an Integrated Computational Tool (I-PREDICT):</p> <p>- Continue integration of I-PREDICT human digital twin into digital engineering efforts for design of platforms (e.g., future vertical lift helicopter, F-18 and F-35) and equipment (e.g., ejection and crew seats, casualty litter support systems, helmets and body armor).</p> <p>- Continue development of a multi-physics computational model that combines a structural human body model with a dynamic musculoskeletal model that enables prediction of injury risk for both acute traumatic and chronic</p>	52.282	44.021	47.440	0.000	47.440
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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<p>repetitive operational exposures. The human digital twin will represent both males and females across a range of body sizes and postures.</p> <p>Fleet Adaptive Multilevel Measurement for Operations & Unit Systems (FAM2OUS): - Complete final testing of the FAM2OUS deliverables, which experienced execution delays in FY22, delaying its completion into FY23.</p> <p>Enhanced Lethality for Maritime Operations (ELMO): - Complete development of ELMO Counter Electronic Attack (CEA) builds 1 through 3. Complete laboratory and flight demonstration and analysis of Advanced CEA modes, builds 2 and 3.</p> <p>Landing Autonomous Navigation Technology for Enhanced Recovery to Navy Ships (LANTERNS): - Complete development of enhanced, Precise Ship-Relative Navigation (PS-RN) for reliable autonomous ship recovery of Unmanned Aerial Systems (UAS) in all weather, high deck motion environments with single vendor selected in FY22. Develop prototype to be used in the Joint Precision Approach & Landing System (JPALS) shore based test site with a surrogate aircraft refined by lessons learned from FY22 prototype laboratory bench test results. Execute shore based prototype test with surrogate aircraft and use results to prepare for CVN test as graduation exercise.</p> <p>Digital Expanded Ultra-High Frequency (UHF) Multiple Input, Multiple Output (MIMO) Optimized Radar (DEUMOR): - Initiate development of high-value signal processing, MIMO, Cognitive & Advanced Space-Time-Adaptive Processing (STAP) algorithms, and advanced antenna technologies for airborne surveillance platforms. - Initiate planning for flight-testing of prototype hardware & software.</p> <p>Prediction of Regional Operational Propagation of HF for EMSO Tactics (PROPHET): - Initiate the development of a high frequency communications planning tool to optimize maritime and shore-based distributed communications that accounts for variability and impact of ionospheric conditions.</p> <p>TEDSat:</p>					

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

	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<p>- Initiate development of a low size, weight, power, and cost electronic warfare payload with required on-board processing to provide a persistent capability not currently available to DoD users.</p> <p>FY 2024 Base Plans: Digital Expanded Ultra-High Frequency (UHF) Multiple Input, Multiple Output (MIMO) Optimized Radar (DEUMOR)</p> <p>- Continue the DEUMOR FNC by continuing development of high-value signal processing, MIMO, Cognitive and Advanced Space-Time-Adaptive Processing (STAP) algorithms, and advanced antenna technologies for airborne surveillance platforms. Perform initial flight testing of prototype hardware and software.</p> <p>Prediction of Regional Operational Propagation of HF for EMSO Tactics (PROPHET)</p> <p>- Continue the PROPHET FNC by continuing development based on the initial prototype and validation and verification studies completed in FY23. Refine the model logic and optimize the processing of ionospheric and high frequency propagation models to provide timely and accurate answers to the warfighter.</p> <p>TEDSat</p> <p>- Continue the TEDSat FNC by continuing development and beginning integration of a low size, weight, power and cost electronic warfare payload with required on-board processing to provide a persistent capability not currently available to DoD users.</p> <p>Incapacitation Prediction in Readiness Domains: an Integrated Computational Tool (I-PREDICT)</p> <p>- Complete the I-PREDICT FNC by transitioning integration of the I-PREDICT human digital twin into digital engineering efforts for design of platforms (e.g., future vertical lift helicopter, F-18 and F-35) and equipment (e.g., ejection and crew seats, casualty litter support systems, helmets and body armor).</p> <p>- Use the most up to date human digital models (male/female, large/small) to develop analyses accounting for variability between people for relevant long (e.g., exposure to high accelerations during vehicle motion) and short duration (e.g., high impacts resulting from blast effects) loading scenarios.</p> <p>- Develop end-user graphical interface tool.</p> <p>- Identify improvements that could be made on future I-PREDICT human body modeling versions.</p> <p>Advanced Autonomous Air-to-Air Refueling System (A4RS)</p>					

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

	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<p>- Initiate design activities, based on an Autonomous Aerial Refueling Modular Open System Architecture study, in support of a tanking MQ-25 with a podded aerial refueling store subsystem and a receiving MQ-25 with a computer vision-based navigation subsystem.</p> <p>Coordinated Advanced Distributed Radio Frequency (RF) Effects (CADRE)</p> <p>- Initiate development of novel technology capabilities to enable advanced distributed and coordinated airborne electronic attack techniques to defeat advanced threats.</p> <p>Modified Aircraft Gamma Inceptor Control Platform Recovery Optimization Program (MAGIC PROP)</p> <p>- Initiate development of baseline system architecture for a preliminary design of the prototype system for E-2D CVN recovery improvements.</p> <p>- Develop new model-based engineering and analytics capabilities required for flight control software simulation.</p> <p>FY 2024 OCO Plans: N/A</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: The increase from FY 2023 to FY 2024 is predominantly due to the initiation in FY 2024 of three FNCs: Advanced Autonomous Air-to-Air Refueling System (A4RS), Coordinated Advanced Distributed Radio Frequency (RF) Effects (CADRE), and Modified Aircraft Gamma Inceptor Control Platform Recovery Optimization Program (MAGIC PROP).</p>					
<p>Title: Information Warfare (IW)</p> <p align="right">Articles:</p> <p>Description: The Information Warfare R-2 Activity focuses on the advanced technology development of new capabilities that leverage the underlying applied research investments in Program Element (PE) 0602750N, Future Naval Capabilities (FNC) Applied Research. These advanced technology investments align to acquisition programs of record. Efforts provide Information Warfare capabilities across several disparate uses and environments.</p> <p>FY 2023 Plans: DECAF:</p>	54.149	58.338	61.912	0.000	61.912
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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)

	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<p>- Continue DECAF development based on underlying analysis done in FY22 to determine effectiveness of a new information warfare capability with test and demonstration events. Initiate transition process into a Program of Record. Additional details are classified.</p> <p>Data Framework for Maritime Operations Center of the Future (DF-MOTF):</p> <p>- Continue to transform Command and Control Decision Making by setting the foundation for artificial intelligence and machine learning big data analytics by consuming data from a single repository with multiple classifications. Continue to develop a multi-level security middleware software tier for Battle Management Aids, Tactical Decision Aids, and Planner applications. Continue to develop middleware containerization software novel solutions to more efficiently use central processing unit and memory resources than typical virtual machine or bare metal deployments that unnecessarily add operating system overhead.</p> <p>Multi-Beam Array for Cooperative Engagement (MACE):</p> <p>- Continue development of a new fully digital, multichannel, multi-beam, communications capability for the Navy's Cooperative Engagement Capability (CEC) to enable significantly more targets to be tracked and engaged.</p> <p>SLQ 32 Signal Identification Improvements (SI^2):</p> <p>- Continue SI2 development and evaluation of new technology to extend machine learning based electronic warfare classification systems in order to improve their capabilities to detect and more accurately characterize modern emitters that are not accurately captured with existing systems.</p> <p>Water-space Planning and Execution for Theater Undersea Warfare (WasP-ET):</p> <p>- Complete development of a new capability for Theater Undersea Warfare Commanders to plan and execute theater Anti-Submarine Warfare operations that eliminates all risk of fratricide and collision with known submerged bodies. Complete development of analytic tools to shorten Commander's decision cycle by automatically gathering, synthesizing, and analyzing data; making recommendations for platform and sensor movement and placement to either avoid or locate adversary submarines. Transitioned to Undersea Warfare-Decision Support System program of record.</p> <p>Long Endurance Airborne Platform (LEAP) Decoy:</p> <p>- Complete development of the LEAP prototype countermeasure vehicle and payload to demonstrate a low size, weight and power (SWaP), long endurance, unmanned, expendable EW decoy capability. Finalize integration efforts started in FY22 and conduct tethered and untethered flight tests of the integrated system. Measure</p>					

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	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<p>detailed antenna and payload performance in a chamber test to verify that the measured technical performance parameters meet system requirements.</p> <p>Data on the Move (DotM):</p> <ul style="list-style-type: none"> - Initiate the Data on the Move FNC with three awards to commercial and government performers by conducting applied research to efficiently exchange information and integrate large amounts of data in real time among distributed commands. - Initiate technology development planning to establish a preliminary design for an initial operational prototype, conduct a stakeholder review of the system approach, and commence development of the initial prototype to support multiple warfighting domains. <p>MAGICO:</p> <ul style="list-style-type: none"> - Initiate development of an innovative orchestration application based on modeling and simulation for coordinated employment of information warfare capabilities. Identify technical performance parameters and system requirements through planning and stakeholder engagements to establish a preliminary design of a prototype that provides outputs to shorten decision cycles while meeting operational intent. <p>FY 2024 Base Plans:</p> <p>Data Framework for Maritime Operations Center of the Future (DF-MOTF)</p> <ul style="list-style-type: none"> - Continue the DF-MOTF FNC by developing and testing a multi-level security architecture that hosts different artificial intelligence and machine learning big data analytic applications. - Continue to develop and test SELinux policies to demonstrate the ability to run data analytics in multi-level security SELinux enforcing mode. - Continue to test and modify middleware containerization software novel solutions to use central processing unit and memory resources more efficiently than typical virtual machine or bare metal deployments that unnecessarily add operating system overhead. <p>Multi-Beam Array for Cooperative Engagement (MACE)</p> <ul style="list-style-type: none"> - Continue the MACE FNC by continuing integration and testing of completed critical subassemblies, leading up to a final integrated prototype planar-array system. - Initiate final TRL 6 test planning and demonstration of the MACE prototype planar-array system. <p>Data on the Move (DotM)</p>					

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<ul style="list-style-type: none"> - Continue the DotM FNC by developing methods for dynamic container deployment and routing at different security level contexts. - Continue to develop container solutions to integrate SE Linux policies with structured and unstructured objects, messaging, and security authorization. - Continue technology development and testing of different hardware and software design prototypes that will meet key performance parameters. <p>MAGICO</p> <ul style="list-style-type: none"> - Continue MAGICO FNC development through modeling and simulation, which are subject to identified technical performance parameters and system requirements. Begin interfacing with the Program of Record (POR) to initiate the transition process and optimize outputs to shorten decision cycles while meeting operational intent. Additional details are classified. <p>DECAF</p> <ul style="list-style-type: none"> - Complete DECAF FNC development and demonstrate the capability in support of transition to the Program of Record. Additional details are classified. <p>SLQ 32 Signal Identification Improvements (SI^2)</p> <ul style="list-style-type: none"> - Complete the SI^2 FNC, evaluating the technology against its exit criteria in a representative environment by testing machine learning based electronic warfare classification systems and their improvements in detection and characterization of modern emitters. Deliver final reports and technology for incorporation into Program of Record (POR) systems. <p>4 Leaf Clovers</p> <ul style="list-style-type: none"> - Initiate data collections and analysis to identify system requirements, conduct stakeholder reviews of the system approach, and initiate development of capabilities. - Initiate simulation model development for distributed signal processing techniques. - Initiate cybersecurity analysis to discover and characterize system vulnerabilities. <p>Federated Learning and Optimization for Wireless networks (FLOW)</p> <ul style="list-style-type: none"> - Initiate system engineering, Modeling and Simulation (M&S) for wireless network optimization with enhanced mission performance. - Conduct design review with stakeholders and commence software prototype development. 					

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<p>Measurement-Based Adaptive Response (M-BAR) - Initiate development of technologies needed to enable real-time adaptive electronic attack techniques to defeat modern anti-ship missile threats.</p> <p>FY 2024 OCO Plans: N/A</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: The increase from FY 2023 to FY 2024 is predominantly due to the initiation in FY 2024 of three FNCS: 4 Leaf Clovers, Federated Learning and Optimization for Wireless networks (FLOW), and Measurement-Based Adaptive Response (M-BAR).</p>					
<p>Title: Surface Warfare (SW)</p> <p align="right">Articles:</p> <p>Description: The Surface Warfare R-2 Activity focuses on the advanced technology development of new capabilities that leverage the underlying applied research investments in Program Element (PE) 0602750N, Future Naval Capabilities (FNC) Applied Research. These advanced technology investments align to acquisition programs of record. Efforts include technologies that will provide mission visualization, network analysis, and training for operators in denied and degraded environments.</p> <p>FY 2023 Plans: Empire - Continue development of Empire, finalizing and demonstrating a software build leveraging SPY-6 backend signal processing in a simulated environment, which will show distributed functions against simulated targets. - Initiate development of a software build for over-the-air testing with surrogate SPY-6 aperture hardware, which will demonstrate distributed capabilities against surrogate targets.</p> <p>Agnostic Signal Processing for Increased Radar Efficiency (ASPIRE): - Continue Iteration 1 hardware design, fabrication and demonstration of next generation SPY-6 digital receiver exciter (DREX) electronics with improved waveform generation capabilities. - Initiate Iteration 2 DREX hardware design, fabrication and demonstration. - Continue fabricating heterogeneous computing (HC) hardware and software design for next generation SPY-6 digital beamformer (DBF).</p>	48.775	55.274	60.112	0.000	60.112
	-	-	-	-	-

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

	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<ul style="list-style-type: none"> - Initiate DBF subsystem integration and demonstration. - Continue to develop representative functions for HC-based SPY-6 signal processor and adaptive digital beamforming (ADBF) electronics. - Document new DREX and HC design performance and space, weight, and power-cooling (SWaP-C) benefits. <p>Amon Hen:</p> <ul style="list-style-type: none"> - Continue Amon Hen development, holding a critical design review of prototype radar illuminator and initiating fabrication of the illuminator aperture and supporting equipment. - Complete the initial build of government-owned backend scheduler software for the illuminator design. - Integrate multi-INT apertures and X-band surface search radar into a modular payload with data fusion processor, then conduct afloat testing on an available surface platform. <p>Conventional Ammunition High Density Reactive Material Augmented Ordnance Systems (CHAOS):</p> <ul style="list-style-type: none"> - Continue development of HDRM into Navy Conventional Ammunition. Further develop the Damaged State Modeling capability for representative targets engaged by Navy Conventional Ammunition. Include comparative analyses of baseline (kinetic energy only) and HDRM (kinetic & reactive energy) ammunition behavior in the Damaged State Models. <p>Receive-Only Cooperative Radar (ROCR):</p> <ul style="list-style-type: none"> - Complete development of this FNC, which experienced execution delays in FY22 and needed to be extended into FY23 to complete S&T development and deliver its technology to acquisition. - Complete over-the-air testing of ROCR software build on SPY-6 surrogate apertures. - Demonstrate receive-only functions and radar communication functions against surrogate targets. <p>Hypersonic-threat Dynamic Reassessment and Adaptation (HyDRA):</p> <ul style="list-style-type: none"> - Complete development of HyDRA, which experienced schedule delays in FY22 and needed to be extended into FY23 to complete S&T development and deliver its technology to the AEGIS Weapon System. <p>Robust Combat Power Control (RCPC):</p> <ul style="list-style-type: none"> - Complete this FNC with development and implementation of the control layers of the shipboard Tactical Energy Management as described in the 2019 Electric Ships Technology Development Roadmap. The FY23 focus will transition the developmental controls implementation from a notional ship reference system instantiated using a Power Hardware In-the-Loop (PHIL) onto an Integrated Power and Energy System Test Facility (ITF) under 					

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

	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<p>development at NSWC PD in support of DDG(X) electrical machinery system testing. The goal would be to confirm FNC exit criteria were met using results of testing conducted.</p> <p>Multi-Spectral High Resolution Targeting Sensor (MUST HITS) - Initiate development of a Digital Read Out Integrated Circuit (DROIC) mated with a high-resolution infrared sensor for detection and tracking of difficult targets.</p> <p>Rough Patch III - Initiate development of a counter Intelligence, Surveillance and Reconnaissance (ISR) prototype.</p> <p>FY 2024 Base Plans: Amon Hen - Continue the Amon Hen FNC by initiating factory testing of the prototype radar illuminator. - Complete design and documentation for interfaces between the illuminator backend scheduler, illuminator hardware, payload assembly, and the test platform. - Complete at-sea testing with multi-INT apertures and other surveillance radars using a modular payload installed on an available surface platform.</p> <p>Multi-Spectral High Resolution Targeting Sensor (MUST HITS) - Continue the MUST HITS FNC by continue development of a Digital Read Out Integrated Circuit (DROIC) mated with a high-resolution infrared sensor for detection and tracking of difficult targets. Begin integration of the camera and processing suite.</p> <p>Rough Patch III - Continue the Rough Patch III FNC by establishing a functional prototype solution that can be evaluated in a simulated relevant environment designed to provide insight into software architectural and transition hardware solutions targeted at achieving Technology Readiness Level 6 by FY26. - Initiate prototype packaging efforts and continue getting operator/fleet input for the mission planning effort.</p> <p>Empire - Complete the Empire FNC by completing development of Empire software and algorithms. - Complete demonstration of distributed radar functions with real SPY-6 signal processing hardware in a simulated environment for comparison with over-the-air testing.</p>					

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

	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<p>- Complete integrating the developmental software build of Empire algorithms into surrogate SPY-6 hardware and conduct over-the-air testing. Resolve potential software defects from developmental builds and summarize performance improvements delivered by the Empire algorithms.</p> <p>Agnostic Signal Processing for Increased Radar Efficiency (ASPIRE)</p> <p>- Complete the ASPIRE FNC by completing testing of the first iteration of a next generation SPY-6 digital receiver exciter (DREX).</p> <p>- Complete fabrication and testing of the second iteration DREX design for SPY-6.</p> <p>- Complete testing of a new Heterogeneous Computing (HC) Digital BeamFormer (DBF) and signal processing backend for the SPY-6.</p> <p>- Characterize the improved waveform generation flexibility provided by the new DREX design and demonstrate representative radar functions provided by the new HC and DBF architectures.</p> <p>Conventional Ammunition High Density Reactive Material Augmented Ordnance Systems (CHAOS)</p> <p>- Complete the CHAOS FNC by completing the integration of off-design, Damaged State, flight performance for representative target models engaged by Navy Conventional Ammunition. The ability of the Damaged State models to discriminate between classes of damage will be evaluated in comparative encounters using baseline (kinetic energy only) and High Density Reactive Material (HDRM) (kinetic and reactive energy) ammunition.</p> <p>Counter-Intelligence, Surveillance and Reconnaissance (C-ISR)</p> <p>- Initiate the integration of the components developed during the tech candidate effort, which will include the design, development, packaging and test for an initial prototype that meets the specified requirements that can be integrated into a designated host system.</p> <p>Crossbow</p> <p>- Initiate development of Decision Aids that enhance the synchronization of Maritime Dynamic Targeting resources for Course of Action options and the monitoring/re-planning and execution of kill-chain timelines for Anti-Surface Warfare Long Range Fires.</p> <p>Radar Advanced Signal Processing (RASP)</p> <p>- Initiate modeling and simulation to characterize long range performance of waveforms transmitted from and received by surface platforms.</p> <p>- Initiate efforts to characterize HF antennas through simulation and field testing.</p>					

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
- Implement initial algorithms for improving HF signal reception in a simulated environment. FY 2024 OCO Plans: N/A FY 2023 to FY 2024 Increase/Decrease Statement: The increase from FY 2023 to FY 2024 is predominantly due to the initiation in FY 2024 of three FNCs: Counter-Intelligence, Surveillance and Reconnaissance (C-ISR), Crossbow, and Radar Advanced Signal Processing (RASP).					
Title: Undersea Warfare (UW) Description: The Undersea Warfare R-2 Activity focuses on the advanced technology development of new capabilities that leverage the underlying applied research investments in Program Element (PE) 0602750N, Future Naval Capabilities (FNC) Applied Research. These advanced technology investments align to acquisition programs of record. Efforts include improvements to a broad range of undersea warfare capabilities, including undersea weapons, submarine acoustic sensing and signal processing systems, communications, electro-optics systems, signature management, training, and decision aids. FY 2023 Plans: VIRGINIA Improved Propulsion Bearing (VIPB): - Continue bearing development. Complete bearing detailed design and critical design review. Complete manufacturing and testing of bearing subcomponents. Continue preparation of manufacturing drawings and purchase of long-lead materials. Conduct test planning for land-based test of the full-scale bearing concept (test scheduled 1QFY26). Multi-Material Propeller Prototype (M2P2) - Continue material coupon and building block testing. - Initiate and complete full scale 688 prototype mechanical concept design. - Initiate full scale 688 prototype mechanical detailed design. - Conduct 1/10th scale testing of full scale 688 prototype hydrodynamic design. - Conduct preliminary design review for full scale 688 prototype design. MK-48 Acoustic Modifications (M&M)	55.432	63.178	64.229	0.000	64.229
Articles:	-	-	-	-	-

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

	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<p>- Continue development of acoustic modification component designs. Down-select components to prototype manufacture. Validate improvements via physics based models and experimental in water measurements.</p> <p>Stern Area System (SAS):</p> <p>- Complete this FNC with analysis of at-sea trial data, and update systems models and software for second at-sea trial. Prepare and execute full function SAS second at-sea trial events to verify system performance. Conduct and document analysis of full function SAS performance.</p> <p>Compact Rapid Attack Weapon (CRAW) Upgrade:</p> <p>- Complete this FNC with a final in-water demonstration of a CRAW launch from a submarine. Complete modifications to submarine fire control that are needed for the CRAW launch demonstration. Complete demonstration of CRAW Anti-Submarine Warfare (ASW) capability.</p> <p>Submarine Tethered Expendable Buoy:</p> <p>- Complete this FNC by completing development of the buoy prototype and conducting final testing of the sensor payload, fiber deployment, and launcher under operational conditions.</p> <p>Own Ship Acoustic Monitoring (OSAM)</p> <p>- Initiate efforts to execute an FY23 at-sea demo to collect data for software development.</p> <p>- Begin development of prototype vulnerability decision aid and monitoring system.</p> <p>Untethered Goat (U GOAT)</p> <p>- Initiate development of a multifunction Intelligence, Surveillance and Reconnaissance (ISR) payload for Unmanned Underwater Vehicles to support distributed maritime operations.</p> <p>FY 2024 Base Plans:</p> <p>VIRGINIA Improved Propulsion Bearing (VIPB)</p> <p>- Continue the VIPB FNC by continuing full scale VIRGINIA Class bearing development, completing preparation of manufacturing drawings and the purchase of bearing long lead materials, conducting a bearing manufacturing readiness review, initiating bearing fabrication, continuing land-based test planning, conducting a land-based test readiness review, conducting a Shaft Line Test Capability (SLTC) critical design review, and initiating SLTC development.</p>					

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
<p>Multi-Material Propeller Prototype (M2P2)</p> <ul style="list-style-type: none"> - Continue the M2P2 FNC by establishing the qualification approach for multi-material structural design (full scale 3-blade/hub prototype), including mechanical requirements for the Design Validation Rotor (DVR). - Conduct Resistance & Powering (R&P) testing in the NSWC tow tank. - Complete the designs for large (1/3) scale rotors to test on the Large-Scale Vehicle (LSV) model at the Acoustic Research Detachment (ARD). <p>Own Ship Acoustic Monitoring (OSAM)</p> <ul style="list-style-type: none"> - Continue the OSAM FNC by conducting an FY24 at-sea demo to collect data for software development and the confirmation of hardware connectivity to ship systems (the FY23 demo was deferred due to ship availability), continuing development of a prototype vulnerability decision aid and monitoring system, continuing software development and the assessment of software performance using FY24 at-sea demo data, and initiating efforts to execute a FY25 at-sea demo to test an initial vulnerability decision aid and a monitoring system prototype hardware/software suite. <p>Untethered Goat (U-GOAT)</p> <ul style="list-style-type: none"> - Continue the U-GOAT FNC by continuing development of a multifunction Intelligence, Surveillance, and Reconnaissance (ISR) payload for Unmanned Underwater Vehicles (UUVs) to support distributed maritime operations. - Continue hardware/software development, fabrication, integration, and demonstration efforts. <p>CRAW Upgrade</p> <ul style="list-style-type: none"> - Complete this FNC by finishing the final demonstration. This demonstration was originally scheduled for FY23, but a delay in submarine availability required it to be rescheduled into FY24. <p>MK-48 Acoustic Modifications (M&M)</p> <ul style="list-style-type: none"> - Complete the M&M FNC by delivering the new component prototype(s) design to NAVSEA PMS404 and providing inputs to NAVSEA's Engineering Change Proposal paperwork. <p>Gravity-Aided Inertial Navigation system (GAINS)</p> <ul style="list-style-type: none"> - Initiate system software and software in the loop simulation for gravity algorithms integrated in the navigation subsystem. - Initiate field testing of existing gravimeter system on test ship. 					

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B. Accomplishments/Planned Programs (\$ in Millions, Article Quantities in Each)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
- Initiate Concept of Operation and implementation studies for new mission profiles. Physical and Networking Layer Prototype (PNLP) - Initiate PNLP FNC with award selection for a multidisciplinary team of industry and government performers to integrate algorithms, hardware, and system test frames for in-water data collection - Initiate hardware and software bench testing in tank environments - Conduct comparative algorithm characterization in a virtual live reconstruction environment, leveraged from the ASTRAnet 6.2 program FY 2024 OCO Plans: N/A FY 2023 to FY 2024 Increase/Decrease Statement: The increase from FY 2023 to FY 2024 is predominantly due to the initiation in FY 2024 of two FNCs: Gravity-Aided Inertial Navigation system (GAINS) and Physical and Networking Layer Prototype (PNLP).					
Accomplishments/Planned Programs Subtotals	248.411	250.993	264.700	0.000	264.700

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

N/A

Remarks

D. Acquisition Strategy

N/A

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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
9999: <i>Congressional Adds</i>	0.000	27.030	18.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	45.030
Quantity of RDT&E Articles		-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other projects

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

	FY 2022	FY 2023
Congressional Add: Advanced Energetics Research	2.896	5.000
FY 2022 Accomplishments: Conduct advanced energetics technology development		
FY 2023 Plans: Conduct advanced energetics technology development		
Congressional Add: Development of Submersible Air Revitalization	0.000	8.000
FY 2022 Accomplishments: N/A		
FY 2023 Plans: Conduct Development of Submersible Air Revitalization research		
Congressional Add: Advanced lidar sensor and data processing	1.931	0.000
FY 2022 Accomplishments: Conduct advanced lidar sensor and data processing advanced technology development		
FY 2023 Plans: N/A		
Congressional Add: Electronic maneuver warfare unmanned sensors	13.515	0.000
FY 2022 Accomplishments: Conduct electronic maneuver warfare unmanned sensors advanced technology development		
FY 2023 Plans: N/A		
Congressional Add: Advance machine learning and artificial intelligence	8.688	0.000
FY 2022 Accomplishments: Conduct advance machine learning and artificial intelligence advanced technology development		
FY 2023 Plans: N/A		
Congressional Add: Advanced carbon nanotube conductors for naval power systems	0.000	5.000

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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
<i>FY 2022 Accomplishments:</i> N/A		
<i>FY 2023 Plans:</i> Conduct research supporting Advanced carbon nanotube conductors for naval power systems		
Congressional Adds Subtotals	27.030	18.000

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

N/A

Remarks

D. Acquisition Strategy

N/A