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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 0603673N / <i>Future Naval Capabilities Advanced Tech Dev</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	221.954	282.020	251.267	-	251.267	264.700	272.130	277.739	283.237	Continuing	Continuing
3346: <i>Future Naval Capabilities Adv Tech Dev</i>	0.000	211.335	254.020	251.267	-	251.267	264.700	272.130	277.739	283.237	Continuing	Continuing
9999: <i>Congressional Adds</i>	0.000	10.619	28.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	38.619

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	231.061	265.299	0.000	-	0.000
Current President's Budget	221.954	282.020	251.267	-	251.267
Total Adjustments	-9.107	16.721	251.267	-	251.267
• Congressional General Reductions	-	-0.217			
• Congressional Directed Reductions	-	-11.062			
• Congressional Rescissions	-	-			
• Congressional Adds	-	28.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-4.711	0.000			
• SBIR/STTR Transfer	-4.396	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	-	-	251.267	-	251.267

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 Subtotals for Project: 9999

Congressional Add Totals for all Projects

	FY 2021	FY 2022
	5.792	3.000
	4.827	0.000
	0.000	2.000
	0.000	14.000
	0.000	9.000
Congressional Add Subtotals for Project: 9999	10.619	28.000
Congressional Add Totals for all Projects	10.619	28.000

Change Summary Explanation

Funding: Decrease from FY22 to FY23 due to the completion in FY22 of multiple FNCs.

Technical: not applicable

Schedule: not applicable

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Appropriation/Budget Activity
1319: *Research, Development, Test & Evaluation, Navy / BA 3: Advanced Technology Development (ATD)*

R-1 Program Element (Number/Name)
PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*

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 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 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
3346: <i>Future Naval Capabilities Adv Tech Dev</i>	0.000	211.335	254.020	251.267	-	251.267	264.700	272.130	277.739	283.237	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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Title: Capable Manpower (CMP)	6.121	0.000	3.000	0.000	3.000
Articles:	-	-	-	-	-
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.					
FY 2022 Plans: N/A					
FY 2023 Base 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.					
FY 2023 OCO Plans:					

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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
N/A					
<p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase from FY22 to FY23 is due to a new FNC being started in FY23 that will develop a capability to simultaneously map manpower, personnel, and training dynamics and outcomes, providing a rapid ability to assess a range of policy and operational decisions using a 'what if' scenario generation process.</p>					
<p><i>Title:</i> Expeditionary Maneuver Warfare (EMW)</p> <p align="right"><i>Articles:</i></p>	31.033	38.626	27.215	0.000	27.215
<p><i>Description:</i> 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, and low observable mine neutralization technologies.</p> <p><i>FY 2022 Plans:</i> Low Observable No Collateral Damage - Neutralization (LONCD-N) System: - Complete development and sea testing of charges, autonomy, 3D LiDAR and subsea wireless communications, and integrate with the Remotely Operated Vehicle (ROV). Conduct shallow water ocean experiments, demonstrations, and data collection with a fully integrated ROV system. Conduct end-to-end deep sea tests and demonstrations of autonomous attachment of mock charges to surrogate sea mines or critical infrastructure by the ROV system utilizing the 3D LiDAR and subsea wireless communications. Demonstrate additional explosive ordnance disposal missions with the ROV system.</p> <p>Compact Encapsulated Mine (C-ENCAP): - Continue activity on technologies for innovative naval mine and mine delivery methods, and integration of these technologies into integrated minefield planning optimization for mixed and multiple minefields. Specific effort includes subcomponent prototype construction, modelling and simulation of explosive characterization. Additional details are</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>classified.</p> <p>Magnetic & Acoustic Generation Next Unmanned Superconducting Sweep (MAGNUSS):</p> <ul style="list-style-type: none"> - Initiate development of a modular, closed-loop, non-towed, high temperature, superconducting magnet, coupled with a low-/non-towed acoustic source for use as a deployable influence mine-sweeping payload aboard any unmanned craft of opportunity. <p>FY 2023 Base Plans:</p> <p>Magnetic & Acoustic Generation Next Unmanned Superconducting Sweep (MAGNUSS):</p> <ul style="list-style-type: none"> - 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>Low Observable No Collateral Damage - Neutralization (LONCD-N) System:</p> <ul style="list-style-type: none"> - 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>Compact Encapsulated Mine (C-ENCAP):</p> <ul style="list-style-type: none"> - Complete design and prototype development for modular payload subcomponent integration, to include energetics characterization. Complete 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 2023 OCO Plans:</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
N/A					
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The decrease from FY22 to FY23 is primarily due to the significant wind down of development activities associated with the Low Observable No Collateral Damage - Neutralization (LONCD-N) System and Compact Encapsulated Mine (C-ENCAP) FNCs, which are scheduled to finish in FY23.					
<i>Title:</i> Air Warfare (AW)	50.537	53.462	44.069	0.000	44.069
<i>Articles:</i>	-	-	-	-	-
<i>Description:</i> 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.					
<i>FY 2022 Plans:</i> Cross-Domain Unmanned Systems (C-D UxS): - Complete C-D UxS effort by employing software in NAVAIR simulator and at Advanced Naval Technology Exercises (ANTX) to demonstrate, assess and mature software for Transfer of Tactical Control (ToTC) of Unmanned Vehicles (UxVs), payloads or data. Demonstrate the implementation of ToTC through a Human Machine Interface that works through the PMA-281 Command Control System Program of Record. Extend C-D UxS ToTC concepts to specifically address requirements of MQ-25 unmanned air vehicle.					
Fleet Adaptive Multilevel Measurement for Operations & Unit Systems (FAM2OUS): - Complete effort by testing FAM2OUS performance measures in relevant simulation environment to quantify impact on mission effectiveness. Test and evaluate the FAM2OUS software toolkit with Advanced Tactics models implemented in the					

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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>Next Generation Threat System (NGTS) at the Integrated Training Facility (ITF) in support of the Integrated Air Defense Course (IADC).</p> <p>Solid State Structural Repair (S3R): - Complete development by finalizing special tooling design required to enable in-situ repair, conducting the necessary validation and verification to enable flight clearance approval, demonstrating in-situ repair across multiple platforms (V-22 and F/A-18) and parts, including flight critical components, and conducting flight operations.</p> <p>Rapid Adaptive Planning for Time-Sensitive Offensive Responsive Strike (RAPTORS): - Complete development of dynamic tactical mission planning tools. Specific focus on integration into micro service architecture, software delivery and laboratory demonstration.</p> <p>Dynamic INtegrated Operations (DINO): - Complete development of software components that work with the Next Generation Naval Mission Planning System (NGNMPS) to enable a decision engagement environment for continuous over-the-horizon (OTH) weapon employment while ensuring targeting chain-of-custody is maintained. Additional details are classified.</p> <p>Electromagnetic Maneuver Warfare Resource Allocation Management (EMW RAM): - Complete development and demonstrate prototype algorithms and integrated software technologies for own-platform and multi-platform resource and task management of EW systems that enable autonomous distributed airborne EW operations at naval tactical ranges and timelines.</p> <p>Advanced Capability Expansion (ACE): - Complete the development of hardware and software and demonstrate via ground and flight test capabilities that focus on extended range targeting and radar electronic attack protection for the E2-D Advanced Hawkeye APY-9 Radar Sub-System.</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>Additional details are classified.</p> <p>Enhanced Lethality for Maritime Operations (ELMO): - Continue development of ELMO performing Counter Electronic Attack (CEA)-1/2 build 1 surrogate flight test and analysis. Procure Hardware Processing Bench and Software Development for Advanced CEA Mode Development. Initiate development of CEA-2 Bld-2. Additional details are classified.</p> <p>Landing Autonomous Navigation Technology for Enhanced Recovery to Navy Ships (LANTERNS): - Continue 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. Specific focus on preliminary designs, down select to single vendor and prototype laboratory demonstrations. Additional details are classified.</p> <p>Incapacitation Prediction in Readiness Domains: an Integrated Computational Tool (I-PREDICT): - Initiate development of a computational model of the living warfighter that enables prediction of injury risk for both acute traumatic and chronic repetitive operational exposures.</p> <p>FY 2023 Base Plans: Incapacitation Prediction in Readiness Domains: an Integrated Computational Tool (I-PREDICT): - 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). - 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 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>					

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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>Enhanced Lethality for Maritime Operations (ELMO):</p> <ul style="list-style-type: none"> - 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>Landing Autonomous Navigation Technology for Enhanced Recovery to Navy Ships (LANTERNS):</p> <ul style="list-style-type: none"> - 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>Digital Expanded Ultra-High Frequency (UHF) Multiple Input, Multiple Output (MIMO) Optimized Radar (DEUMOR):</p> <ul style="list-style-type: none"> - 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>Prediction of Regional Operational Propagation of HF for EMSO Tactics (PROPHET):</p> <ul style="list-style-type: none"> - 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>TEDSat:</p> <ul style="list-style-type: none"> - 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>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The decrease FY 2022 to FY 2023 is due to the completion in FY22 of the Cross-Domain Unmanned Systems (C-D UxS), Solid State Structural Repair (S3R), Dynamic INtegrated Operations (DINO), RAPTORS,</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
Electromagnetic Maneuver Warfare Resource Allocation Management (EMW RAM), and Advanced Capability Expansion (ACE) FNCs.					
<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 2022 Plans: The increase in Information Warfare funding from FY 2021 to FY 2022 is primarily due to the initiation of three high priority FNCs in FY 2022: MACE, DF-MOTF, and SI^2. The initiation of Multi-Beam Array for Cooperative Engagement (MACE) will provide the first fully digital communications system in the fleet, and the design of this communications system will be adaptable for other shipboard and expeditionary systems. The initiation of a fully informed Data Framework for the Maritime Operations Centers of the Future (DF-MOTF) is a significant Fleet priority for warfighting that can only be discussed in a classified forum. The initiation of the SLQ 32 Signal Identification Improvements (SI^2) FNC will increase the survivability of surface platforms by making urgently needed improvements to the Navy's Electronic Warfare program of record.</p> <p>Extended Range - Directional Frequency Analysis and Recording (ER-DIFAR) Sonobuoy: - Complete development and testing of an A-size passive sonobuoy system capable of delivering the required array gain for target detection, localization, and measurement at the required range.</p> <p>Advanced Naval Super Wideband Energy Receiver (ANSWER): - Complete development of advanced algorithms and signal processing capabilities for integration with next-generation, super-wide bandwidth recording systems. Demonstrate the capability in the field for rapid technology insertion into naval systems. Additional details are classified.</p>	39.942	55.372	58.402	0.000	58.402
	-	-	-	-	-

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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>Water-space Planning and Execution for Theater Undersea Warfare (WasP-ET):</p> <ul style="list-style-type: none"> - Continue development of a dynamic and adaptive Prevention of Mutual Interference/Water Space Management (PMI/WSM) application that delivers a new weapons engagement planning capability for Anti-Submarine Warfare (ASW) scenarios. Continue the development of machine learning and optimization algorithms that automatically de-conflict blue on blue weapon engagements while dynamically assigning blue on red engagements based on exploited intelligence information and tactical contact reporting to generate probabilistic estimates of target location, intended mission, and projected location. <p>Long Endurance Airborne Platform (LEAP) Decoy:</p> <ul style="list-style-type: none"> - Continue development of LEAP Technologies. Due to FY21 funding cuts, FY22 Plans have been compressed with the CounterMeasure (CM) preliminary design review scheduled in the 1st Quarter, followed by detailed design, which will include the launcher. Planned risk reduction tests will include a chamber test measuring antenna isolation performance. CM component and integration tests will be conducted and test plans will be developed for tethered and untethered flight tests of two prototypes. <p>DECAF:</p> <ul style="list-style-type: none"> - Continue DECAF by finishing the underlying analysis and continuing development of a new information warfare capability for a field demonstration. Additional details are classified. <p>Data Framework for Maritime Operations Center of the Future (DF-MOTF):</p> <ul style="list-style-type: none"> - Additional details are classified. <p>Multi-Beam Array for Cooperative Engagement (MACE):</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 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>- Initiate development of new technology that extends existing machine learning based electronic warfare classification systems and expands their capabilities to detect and more accurately characterize modern emitters not accurately captured with existing systems.</p> <p>FY 2023 Base Plans:</p> <p>DECAF:</p> <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>					

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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>- 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: - 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 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): - 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> <p>MAGICO: - 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> <p>FY 2023 OCO Plans: N/A</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</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
The increase from FY 2022 to FY 2023 is due primarily to the initiation in FY23 of the Data on the Move (DotM) and MAGICO FNCs.					
<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 2022 Plans: The increase in Surface Warfare from FY 2021 to FY 2022 is primarily due to the initiation of three high priority FNCs in FY22: ASPIRE, Amon Hen and CHAOS. Agnostic Signal Processing for Increased Radar Efficiency (ASPIRE) will improve operations in highly contested and environmentally complex waters by increasing the Navy's capability for distributed maritime operations and long-range targeting. Amon Hen will provide the Fleet with improved situational awareness, increasing the survivability of the High Value Unit while it operates in EMCON. Conventional Ammunition High Density Reactive Material Augmented Ordnance Systems (CHAOS) will increase the lethality of conventional weapon projectiles. Several efforts involving the SPY-6 each involve unique, specific, and needed aspects of the entire system.</p> <p>Fleet Training Technologies (FleeT2): - Complete development of FleeT2 by extending simulations and training technologies to include models for theater specific operations in denied/degraded environments (D2E) for Strike Group Warfare Commanders. This includes developing</p>	38.927	49.876	55.334	0.000	55.334
	-	-	-	-	-

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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>D2E training interventions and adapted models for Strike Group Commanders and additional D2E models that address anticipated adversarial tactics and techniques for strike group training and certification.</p> <p>Receive-Only Cooperative Radar (ROCR): - Complete development of a receive-only capability for the SPY-6 product line that improves situational awareness during Emissions Control (EMCON) and improves radar timelines with advanced waveforms for communications and radar operations.</p> <p>Hypersonic-threat Dynamic Reassessment and Adaptation (HyDRA): - Complete development of modifications to the AEGIS Weapon System. Additional details are classified.</p> <p>Robust Combat Power Control (RCPC): - Continue to develop and implement the control layers of the shipboard Tactical Energy Management as described in the 2019 Electric Ships Technology Development Roadmap, with the FY22 focus being on the controls implementation on a notional ship reference system instantiated using a Power Hardware In-the-Loop (PHIL). This effort will enable shipboard power for future electric weapons.</p> <p>Empire: - Continue development of efficient computational techniques for signal processing on SPY-6 for a heterogeneous processing framework, improving resilience and situational awareness in contested electromagnetic environments and increasing the capacity for distributed maritime operations and the survivability of platforms.</p> <p>Agnostic Signal Processing for Increased Radar Efficiency (ASPIRE): - Initiate development of new technology that increases the performance and reduces the size, weight, power and cost of</p>					

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

the SPY-6 digital receiver and exciter, beam-former and backend signal processor to counter the proliferation of advanced threats and support distributed radar network operations within contested waters.

Amon Hen:
 - Initiate development of a low cost portable multi-sensor multi-function C5ISR-T capability that is supports a maneuverable illuminator for unmanned surface vehicles that is compatible with SPY-6 and other radars receiving apertures.

Conventional Ammunition High Density Reactive Material Augmented Ordnance Systems (CHAOS):
 - Initiate development of the capability to integrate High Density Reactive Material (HDRM) into conventional ammunition.

FY 2023 Base 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.

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).
 - 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.

Amon Hen:

FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total

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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 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 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>Multi-Spectral High Resolution Targeting Sensor (MUST HITS)</p> <ul style="list-style-type: none"> - Initiate development of a Digital Read Out Integrated Circuit (DROIC) mated with a high-resolution infrared sensor for detection and tracking of difficult targets. 					

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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
Rough Patch III - Initiate development of a counter Intelligence, Surveillance and Reconnaissance (ISR) prototype. FY 2023 OCO Plans: N/A FY 2022 to FY 2023 Increase/Decrease Statement: The increase from FY 2022 to FY 2023 is due primarily to the initiation of the Multi-Spectral High Resolution Targeting Sensor (MUST HITS) and Rough Patch III FNCs in FY23.					
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 2022 Plans: The increase in Undersea Warfare from FY 2021 to FY 2022 is primarily due to the ramp up of technology development efforts for the VIPB FNC and the initiation in FY 2022 of two high priority FNCs: M2P2 and M&M. The VIRGINIA Improved Propulsion Bearing (VIPB) is a highly important FNC for the submarine program that reduces Risk reduction for the COLUMBIA class submarine. Commencing the manufacturing of a full-scale prototype bearing and starting the fabrication of the scale shaft-line test bed in FY22 are the reasons this FNC's cost went up substantially. The Multi-Material Propeller Prototype (M2P2) will reduce the weight of submarine propellers enabling greater payload fraction/speed and will reduce the cost of Fleet operations as it will be removable and repairable without needing to dry-dock. The MK-48 Acoustic Modifications (M&M) FNC will substantially improve this heavyweight torpedo's probability of kill. Stern Area System (SAS):	44.775	56.684	63.247	0.000	63.247
Articles:	-	-	-	-	-

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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>- Continue analysis of FY21's first SAS at-sea trial. Analysis will include the evaluation of SAS system hardware and software performance, and preparations for a full functional SAS demonstration at sea in FY23. Additional details are classified.</p> <p>Diver Augmented Vision Display with Enhanced Communications (DAVD):</p> <p>- Complete development of DAVD by coordinating demonstration and acceptance testing with NAVSEA OOC and Fleet Units as the system migrates to DAVD Gen 3. Working with Fleet and Technical Representatives; develop preventive maintenance plans for the entire DAVD System (topside box, tether and Helmet system to include integrated sonar systems) and integrate procedures into the Navy Preventive Maintenance System (PMS).</p> <p>Avalanche:</p> <p>- Complete this activity on undersea persistence and infrastructure. The prototyping of long endurance autonomy and hardware solutions for fixed and deployable energy sources and heterogeneous communication networks will be complete and a system of systems design package complete.</p> <p>Submarine Propagation Channel Assessment & Prediction (subPCAP):</p> <p>- Complete software integration of the environmental assessment and prediction module within the BLQ-10 and APB programs.</p> <p>Compact Rapid Attack Weapon (CRAW) Upgrade:</p> <p>- Continue this FNC with an in-water demonstration of the Anti-Submarine Warfare (ASW) capability with a submarine launched CRAW.</p> <p>Advanced Broadband Navigation Sonar System (ABNSS):</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>- Complete development and transition of new sonar waveforms for the submarine force for employment in the navigation sonar system to improve performance and reduce operational constraints.</p> <p>VIRGINIA Improved Propulsion Bearing (VIPB):</p> <p>- Continue this FNC with the FY22 focus to include the start of manufacturing of the full-scale VIRGINIA bearing and the start of fabrication of components of the scale shaft-line test bed. Additional details are classified.</p> <p>Submarine Tethered Expendable Buoy:</p> <p>- Continue development of buoy prototype by testing sensor payload, fiber deployment, and launcher.</p> <p>Multi-Material Propeller Prototype (M2P2)</p> <p>- Initiate development of techniques for incorporating multi-materials into propeller design to reduce propeller weight, while providing the required thrust. Benefits include greater ship design flexibility and reduced cost to the Fleet for operations and repair. Additional details are classified.</p> <p>MK-48 Acoustic Modifications (M&M)</p> <p>- Initiate development of acoustic modifications to the MK-48 torpedo that will improve the weapon's probability of kill.</p> <p>FY 2023 Base Plans:</p> <p>VIRGINIA Improved Propulsion Bearing (VIPB):</p> <p>- 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).</p> <p>Multi-Material Propeller Prototype (M2P2)</p> <p>- Continue material coupon and building block testing.</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
<ul style="list-style-type: none"> - 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. <p>MK-48 Acoustic Modifications (M&M)</p> <ul style="list-style-type: none"> - 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>Stern Area System (SAS):</p> <ul style="list-style-type: none"> - 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>Compact Rapid Attack Weapon (CRAW) Upgrade:</p> <ul style="list-style-type: none"> - 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>Submarine Tethered Expendable Buoy:</p> <ul style="list-style-type: none"> - 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>Own Ship Acoustic Monitoring (OSAM)</p> <ul style="list-style-type: none"> - Initiate efforts to execute an FY23 at-sea demo to collect data for software development. - Begin development of prototype vulnerability decision aid and monitoring system. <p>Untethered Goat (U GOAT)</p> <ul style="list-style-type: none"> - Initiate development of a multifunction Intelligence, Surveillance and Reconnaissance (ISR) payload for Unmanned Underwater Vehicles to support distributed maritime operations. <p><i>FY 2023 OCO Plans:</i></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
N/A					
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> The increase from FY 2022 to FY 2023 is primarily due to the initiation of two new Undersea Warfare FNCs that will provide an acoustic monitoring system for the next nuclear submarine class and identify feasible modifications to upgrade the monitoring system of current submarine classes, and develop a new payload and software for the Medium Unmanned Undersea Vehicle (UUV) Program.					
Accomplishments/Planned Programs Subtotals	211.335	254.020	251.267	0.000	251.267

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 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	10.619	28.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	38.619
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 2021	FY 2022
Congressional Add: Advanced Energetics Research FY 2021 Accomplishments: FY21 funds will be used toward the advanced demonstration of energetic materials in weapon system applications to include: high performance solid rocket propulsion, advanced liquid fuels for air breathing weapon system propulsion, novel advanced warhead demonstrations focused on advanced ship defeat capabilities, and the demonstration of modeling and simulation capabilities to predict weapon system lethality and effectiveness specifically accounting for non-traditional lethal effects and the quantification of their damage potential on adversary weapon systems. FY 2022 Plans: Conduct advanced energetics technology development	5.792	3.000
Congressional Add: Development of Submersible Air Revitalization FY 2021 Accomplishments: Conducted advanced technology development of submersible air revitalization. FY 2022 Plans: N/A	4.827	0.000
Congressional Add: Advanced lidar sensor and data processing FY 2021 Accomplishments: N/A FY 2022 Plans: Conduct advanced lidar sensor and data processing advanced technology development	0.000	2.000
Congressional Add: Electronic maneuver warfare unmanned sensors FY 2021 Accomplishments: N/A FY 2022 Plans: Conduct electronic maneuver warfare unmanned sensors advanced technology development	0.000	14.000
Congressional Add: Advance machine learning and artificial intelligence	0.000	9.000

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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
<i>FY 2021 Accomplishments:</i> N/A		
<i>FY 2022 Plans:</i> Conduct advance machine learning and artificial intelligence advanced technology development		
Congressional Adds Subtotals	10.619	28.000

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

N/A

Remarks

D. Acquisition Strategy

N/A