Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Navy	Date: February 2020
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603673N *I Future Naval Capabilities Advanced Tech Dev*

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	0.000	210.631	222.477	246.054	-	246.054	268.542	261.771	275.795	284.452	Continuing	Continuing
3346: *Future Naval Capabilities Adv Tech Dev*	0.000	203.391	221.277	246.054	-	246.054	268.542	261.771	275.795	284.452	Continuing	Continuing
9999: *Congressional Adds*	0.000	7.240	1.200	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.440

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. Pursuing this mission, 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 program, which provides technology solutions to known requirements, and often responds to cost, schedule and performance challenges in acquisition to accelerate capability delivery.

The efforts described in this Program Element (PE) 0603673N for FNC Advanced Technology Development have emerged from earlier research conducted in PE 0602750N for FNC Applied Research, and have transition funding commitments from the receiving acquisition Program of Record. Each effort in this PE is assessed and selected for its payoff to the naval warfighter, technological maturity and stakeholder commitment to deploy it to the Fleet/Force.

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

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

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Navy	Date: February 2020
Appropriation/Budget Activity 1319: *Research, Development, Test & Evaluation, Navy I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603673N *I Future Naval Capabilities Advanced Tech Dev*

B. Program Change Summary ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	214.184	231.907	281.953	-	281.953
Current President's Budget	210.631	222.477	246.054	-	246.054
Total Adjustments	-3.553	-9.430	-35.899	-	-35.899
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-10.630			
• Congressional Rescissions	-	-			
• Congressional Adds	-	1.200			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-3.553	0.000			
• Program Adjustments	0.000	0.000	-35.899	-	-35.899
• Rate/Misc Adjustments	0.000	0.000	0.000	-	0.000

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2019	FY 2020
Project: 9999: *Congressional Adds*		
Congressional Add: *Advanced Development of High Yield Conventional Energetics*	7.240	0.000
Congressional Add: *Automated critical care system*	0.000	1.200
Congressional Add Subtotals for Project: 9999	7.240	1.200
Congressional Add Totals for all Projects	7.240	1.200

Change Summary Explanation

Funding: The programmatic decrease of $35.899M in FY 2021 and are in accordance with Office of the Secretary of Defense (OSD) steady-state guidance for S&T. Efforts are justified in Project 3346.

Technical: Not applicable.

Schedule: Not applicable.

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	Project (Number/Name) 3346 / *Future Naval Capabilities Adv Tech Dev*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
3346: *Future Naval Capabilities Adv Tech Dev*	0.000	203.391	221.277	246.054	-	246.054	268.542	261.771	275.795	284.452	Continuing	Continuing

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)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Title: Capable Manpower (CMP)	7.514	10.640	6.400	0.000	6.400
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 2020 Plans: The advanced technologies being developed under this R-2 Activity in FY20 include technologies supporting the future integrated training environment and ready relevant learning. Training simulator software and hardware to support the rapid integration and interoperability of air and ground legacy and future simulation-based training is being developed to address the shortfall in sorties needed to maintain readiness for integrated air and ground operations of the marine air-ground task force. This technology will allow pilots and aircrews to train effectively in a common, simulated operating environment. Flexible and interoperable learning continuum and performance aids will be developed, providing individual career management, skill classification, selection, automatic training content re-engineering, supervisor evaluations, and Fleet readiness tracking. New machine learning algorithms will input training data from the lifelong learning record, and output a training model that is usable for adaptive					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
training. The focus on ready relevant training will accelerate learning, reduce the decay of acquired skills, and provide readiness tracking of performance at an individual level. ***FY 2021 Base Plans:*** Learning Continuum and Performance Aid (LCaPA): - Further develop machine learning algorithms to process and analyze training data from multiple legacy databases in order to modularize content delivery systems for manpower management. Streamlined Marine After-Action Review Tool - Visualization (SMART-Viz) - In collaboration with a complementary effort funded in PE 0603640M - Marine Corps Advanced Technology Demonstration, initiate technologies that provide timely and improved feedback to warfighters to enhance learning in live and simulated environments. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The decrease from FY20 to FY21 is primarily due to the completion in FY20 of the Navy's investment in the Future Integrated Training Environment (FITE) FNC.					
Title: Expeditionary Maneuver Warfare (EMW) ***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. ***FY 2020 Plans:*** The advanced technologies being developed under this R-2 Activity in FY20 include those efforts that focus on Mine Countermeasures (MCM) task force planning, multi-mission airborne mine detection, and mine neutralization without collateral damage. Mission management tools will be developed for the Mine Countermeasures Commander to assist in the planning and re-planning, scheduling, and allocation of MCM task force assets using an extremely modular, open systems approach. This will provide MCM Commanders with the ability to rapidly re-plan and schedule emerging LCS/MCM Mission Package assets and maintain situational awareness of heterogeneous groups of systems. The investment in single-system, day/night, multi-mission airborne mine detection technologies usable at all water depths will be increased in order to reduce	5.840	14.119	37.233	0.000	37.233

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
the MCM timeline and facilitate our capability to counter surface/near surface mines in the Surf Zone or Beach Zone (BZ) at night. The viability of the preliminary design and schedule to support Fire Scout integration will be thoroughly explored. New mine neutralization technologies will enhance the effectiveness and efficiency of Navy expeditionary force capabilities in their assigned response mission to counter naval mine and maritime improvised explosive device threats. This technology will enhance the capability of the Maritime Expeditionary Standoff Response (MESR) System of Systems.					
FY 2021 Base Plans: Low Observable No Collateral Damage-Neutralization (LONCD-N) System: - Continue activity on technologies for low observable mine neutralization without collateral damage. Specific effort includes subcomponent prototype construction, in-water experimentation, and initial data collection. These alternative mine neutralization technologies will enhance the capability of the Maritime Expeditionary Standoff Response (MESR) System of Systems and enable more clandestine MCM operations in support of JFEO. Single-system Multi-mission Airborne Mine Detection (SMAMD): - Complete activity on multi-mission airborne mine detection. Effort will include integrating the prototype airborne mine detection capability on an unmanned platform (currently targeting the MQ-8C Fire Scout); conducting a final demonstration; and collecting final performance data for transition. The desired outcome of this effort is a single-system, airborne mine detection technology to reduce the MCM timeline and facilitate our capability to counter surface and near-surface moored/drifting mines from deep water thru the Surf Zone (SZ), and proud mines on the Beach Zone (BZ), day or night. Compact Encapsulated Mine (C-ENCAP) - Initiate development of an alternative clandestine mine with flexible depth capability, improved lethality, payload-agnostic and Weapon System Explosives Safety Review Board (WSESRB)-compliant encapsulation, and multimodal sensing with multi-field planning software.					
FY 2021 OCO Plans: N/A					
FY 2020 to FY 2021 Increase/Decrease Statement:					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
The increase from FY20 to FY21 is primarily due to an FY21 ramp-up of the Navy's investment in a Low Observable No Collateral Damage - Neutralization (LONCD-N) System and a new investment starting in FY21 for a Compact Encapsulated Mine (C-ENCAP).					
Title: Force Health Protection (FHP) ***Description:*** The Force Health Protection 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 or record. ***FY 2020 Plans:*** N/A ***FY 2021 Base Plans:*** N/A ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** N/A	0.802	0.000	0.000	0.000	0.000
Title: Air Warfare (AW) ***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. ***FY 2020 Plans:*** The advanced technologies being developed under this R-2 Activity in FY20 include those efforts that focus on enhanced corrosion protection for aircraft surfaces and galvanic interfaces in order to improve durability and reduce toxicity/exposures, advanced radio enhancements for long range anti-ship missiles and other weapons,	34.614	38.871	55.947	0.000	55.947

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
human machine interface and vehicle controller command and control technologies that implement full and partial UxV transfer of control and discovery, software performance assessment tools to automatically collect, fuse, display, analyze, and archive live virtual constructive training data from disparate systems, and multi-platform technologies for collaborative airborne manned and unmanned tactical electronic warfare operations at all jamming ranges.					
FY 2021 Base Plans: Cross-Domain Unmanned Systems (C-D UxS): - Further develop software and strategy to permit messaging between unmanned platforms and payloads in order to operate across the critical safety boundaries for unmanned systems groups. Fleet Adaptive Multilevel Measurement for Operations & Unit Systems (FAM2OUS): - Develop software toolkit to insert Advanced Tactics models into the Next Generation Threat System (NGTS). - Implement objective human performance measurement algorithms in the NGTS Analysis and Reporting Tool. Rapid Adaptive Planning for Time Sensitive Offensive Responsive Strike (RAPTORS): - Commence development of a many-on-many mission planning tool for salvos of weapons engaging adversary surface action groups. -Dynamic INtegrated Operations (DINO): - Continue the development of a Warfare Commanders Portal that provides an interface for the digital sharing of information from diverse ISR and mission planning/execution data sources across the entire kill chain. Artificial Intelligence is generating and ranking tactical strike mission courses of action based on this data, which will be provided to the Mission Commander. Electromagnetic Maneuver Warfare Resource Allocation Management (EMW RAM): - Continue development and demonstration of 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. The primary objective is to develop multi-platform airborne technologies for collaborative many-on-many manned & unmanned EW operations across all jamming ranges. Prototype software development and documentation includes an EW Battle Management (EWBM) framework, an advanced EW Adaptive System Management for lower-level resource					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
allocation management, and own-platform hybrid teaming between naval aircrews and machines for improving tactical mission effectiveness while reducing human workloads. Advanced Capability Expansion (ACE): - Continue the development of hardware and software that focus on extended range targeting and radar electronic attack protection for the E2-D Advanced Hawkeye APY-9 Radar Sub-System. - Solid State Structural Repair (S3R) - This effort will continue with a focus on beginning development of a Design of Experiments (DoE) to identify the Cold Spray process parameters for producing the optimal combination of adhesion, tensile, fatigue and ductility needed to perform structural repairs on Al-7050. The process parameters include gas type, gas pressure, gas temperature, nozzle raster or traverse speed, raster pattern, nozzle standoff distance, surface preparation and nozzle design. Enhanced Lethality for Maritime Operations (ELMO) - In collaboration with a complementary effort funded in PE 0603640M - Marine Corps Advanced Technology Demonstration, initiate development of new Multi-Function Sensor (MFAS) modes for the MQ-4C Triton Unmanned Aircraft System (UAS), enhancing Distributed Maritime Operations (DMO) with the Next Generation Network (NGN). Landing Autonomous Navigation Technology for Enhanced Recovery to Navy Ships (LANTERNS) - Initiate 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. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The increase from FY20 to FY21 is primarily due to new investments starting in FY21 involving Solid State Structural Repair (S3R), Triton Enhanced Lethality for Naval Operations (ELMO) and Landing Autonomous Navigation Technology for Enhanced Recovery to Navy Ships (LANTERNS).					
Title: Information Warfare (IW)	73.074	61.814	50.169	0.000	50.169

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
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. ***FY 2020 Plans:*** The advanced technologies being developed under this R-2 Activity in FY20 cover rapidly evolving technological areas and include those that: a)enable distributed and networked sensor and weapon control by providing a communications interface for combat systems applications, b) deliver data and information via any combination of available tactical data links, c) enhance security, d) provide an improved capability to detect and track the newest generation of ultra-quiet submarines in the deep ocean, e) provide the surface fleet with a position fixing capability in a Global Positioning System (GPS) denied environment, f) correlate multi-sensor, multi-platform, radio-frequency, geo-location data to create a passive common operating picture and enable coordinated engagements of multi-mode, multi-aspect, threat sensors using networked tactical electronic warfare and information operations systems, g) build on networked electronic warfare infrastructures to provide new user interfaces for multi-platform, coordinated electronic support and electronic attack techniques, h) sense and assess real-time environmental conditions to improve sensor performance forecasting and automate the detection of very quiet targets within undersea surveillance barriers, and i) develop technologies that can be demonstrated in an 'A'-size sonobuoy capable of delivering the array gain required to localize and collect passive acoustic intelligence of ultra-quiet submarines at tactically relevant ranges through exploitation of a unique feature of the sound channel. ***FY 2021 Base Plans:*** Extended Range-Directional Frequency Analysis and Recording (ER-DIFAR) Sonobuoy: - Specific effort will include building and demonstrating an A-size (i.e., fits existing standard sonobuoy deployment chute) passive sonobuoy system capable of delivering the required array gain for target detection, localization, and measurement at the required range. It will also involve development of the Build 2 software using the prototype array and Build 1 software prototypes with lake test data. It will also involve conducting an at-sea checkout and integration into the into Build 1 processor hardware in the laboratory configuration. The desired outcome for ER-DIFAR is to provide acoustic intelligence to the Type Commander to aid in decisions for achieving readiness in warfighting enterprises in accordance with CNO's "Design for Maintaining Maritime Superiority version 2.0, Line of Effort Blue: Strengthen Navy Power at and from the Sea"					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
SCAMM - Complete development of SCAMM for the Ship's Signal Exploitation Equipment (SSEE) program. Propagation Channel Assessment and Prediction (PCAP): - Specific effort will involve completing the development and testing of software and algorithms for ship RF systems that incorporate observed and predicted atmospheric conditions to provide ranges against signals of interest. It will also involve integration of PCAP into SLQ-32(V)6 Program of Record for final demonstration and testing. ACES: - Complete development of advanced adversary platform identification from non-traditional methods. Demonstrate this capability in an autonomous vehicle. Complete current and emerging protocol analyses. Advanced Naval Super Wideband Energy Reciever (ANSWER): - Continue development of a next generation recorder capable of processing a minimum of 20GHZ of simultaneous dynamic bandwidth. Demonstrate the recorder in the field to collect metrics and performance for rapid technology insertion into Naval systems. Acoustic Automation Processing for Undersea Surveillance Barriers: - Conclude activity in Acoustic Automated Processing (AAP) for Fixed Surveillance Systems. Specific effort will include delivering software and algorithms that automate the processes of cross-sensor correlation and signature recognition. Conduct testing to ensure these algorithms achieve suitable probability of detection vs. very quiet targets at the required range and reduce the False Alarm Rate. Refinement of prototype algorithms will complete and then they will be tested and integrated into the Fixed Surveillance System (FSS) in preparation for demonstration at the PMS 485 Test Bed Facility. The desired outcome is to provide early warning of threat submarines intruding into the ocean commons to the warfighter via the Fixed Surveillance System (FSS) to aid in protecting the sea lines of communication between the United States and its allies and partners. This is directly supporting the CNO's "Design for Maintaining Maritime Superiority, version 2, Line of Effort Blue: Strengthen Navy Power at and from the Sea." High Frequency Ionospheric and Ocean Scatter for Tactical Maneuver (HIFIOS-TM): - Complete development of this FNC for the Ships Signal Exploitation Equipment (SSEE) Family of Systems (FoS) Medusa-Next program.					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Water-space Planning and Execution for Theater Undersea Warfare (WasP-ET) - Initiate development of a dynamic and adaptive Prevention of Mutual Interference / Water Space Management (PMI/WSM) application that works in a multi-level security environment, enabling integration of allied and coalition forces with a process that involves sound operations research, machine learning, and intelligent agent capabilities. Long Endurance Airborne Platform (LEAP) Decoy - Initiate development of a rapidly deployable, long endurance, unmanned, airborne advanced decoy with an advanced electronic warfare capability that can counter varied threats while maintaining continuous ship communications. DECAF - Initiate development of a new information warfare capability termed DECAF. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The decrease from FY20 to FY21 is primarily due to the completion in FY20 of multiple FNCs, including Communications as a Service (CaaS), Mission-based Networking for DDS (MiND), Deep Reliable Acoustic Path Exploitation System (DRAPES), Network Collaborative Precision Navigation and Timekeeping (NCPNT), Coordinated Radio Frequency EW (CRFEW) and Next Generation Surface Electronic Warfare User Interface.					
Title: Surface Warfare (SW)	32.436	44.474	44.965	0.000	44.965
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. ***FY 2020 Plans:*** The advanced technologies being developed under this R-2 Activity in FY20 include those efforts that focus on: a) high density, modular and configurable, high cycle rate, megawatt-scale multifunction energy storage systems					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
for electric weapons and sensor loads that are necessary to provide continuous operational availability, b) the integration testing necessary to implement attack resilient architectures and toolsets that can be retrofitted to both legacy and modern shipboard control systems, c) the incorporation of high density reactive materials into warheads such as the ALaMO 57mm round so as to significantly increase lethality without requiring changes to flight dynamics, guidance, and/or interaction with the respective weapon system, d) advanced alloys and airfoil coatings for Gas Turbine hot section components that will realize a 3X improvement in engine life at higher operating temperatures and pressures, improving the mean time between failure of these expensive ship engines, e) technologies that counter unmanned aerial surveillance drones, f) training for staffs and operators required to conduct command and control against peer threats in degraded and denied environments, g) a new electronic initiation safety device for energetic initiation for both SM-6 and SM-2 upgrades, h) a receive-only capability on SPY-6V1 for improved situational awareness during EMCON and improved radar timelines with advanced waveforms for communications and radar operation, and i) modular virtual-constructive simulation technologies, realistic phenomenology and behavior models for synthetic entities in support of warfighter command Ttam and platform operator staff multi-mission training, assessment and certification.					
FY 2021 Base Plans: Fleet Training Technologies (FleeT2): - Create a cross-platform, mission-centric, simulation for training and assessment of staff and operators in denied and degraded environments. Develop tools to permit more real-time debriefing of operators and command staff. Standard Missile Qualified Universal Initiation Baseline (SQUIB): - Finalize maturation of an Electronic Ignition Safety Device (EISD)/Safety Module Assembly and integrate it into prototypical Rocket Motors in STANDARD Missile 6 (SM-6) Block IB Demonstration Propulsion Units (DPUs). The resulting Technical Data Package (TDP) will serve as a basis to issue an Request for Proposals (RFP) for transition of the EISD/Safety Module Assembly to a contractor for industry upgrade, ensuring producibility and Design Verification Testing (DVT). SCRAM: - Complete development of SCRAM for Hull, Mechanical and Electrical (HM&E) systems, combat and navigation systems, and the NATO Sea Sparrow Missile System (NSSMS) program. Receive-Only Cooperative Radar (ROCR):					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
- Continue to develop 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. Hypersonic-threat Dynamic Reassessment and Adaptation (HyDRA): - Continue to develop modifications to the AEGIS Weapon System. Robust Combat Power Control (RCPC) - Initiate development of a power control system enabling tactical energy management within a ship's Integrated Power and Energy System (IPES), employing shared zonal energy storage to ensure power and energy accessibility to all mission critical equipment. Electronic MIMO Protection for Ensured Radar Effect (EMPIRE) - Initiate 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. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:*** No significant change from FY2020 to FY2021.					
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 2020 Plans:*** The advanced technologies being developed under this R-2 Activity in FY20 include those efforts that focus on a) simultaneous transmit and receive capabilities for radio frequency antenna apertures as well as the backend	49.111	51.359	51.340	0.000	51.340

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
processing that enable stealthy submarine information operation missions, b) an integrated combat capability to the Submarine Payload Control System that supports collaborative planning, payload coordination, briefing, and enhanced mission execution through seamless integration with the unmanned vehicle controller, c) reducing the signature of current and future submarines in order to enhance their military effectiveness, d) automated data analysis for expeditionary mine countermeasures, e) a modular and adaptive electronic warfare trainer, scenario generator and digital stimulator that's applicable to multiple training facilities and air, surface, and undersea platforms, f) high performance submersible radar absorbing structures that use advanced manufacturing techniques to improve affordability, durability, scalability, and the performance of submarine mast materials, and g) technologies offering a covert broadband acoustic signal structure with advanced processing algorithms that will increase an SSBN's ability to conduct bathymetric fixes in a wider range of operational environments.					
FY 2021 Base Plans: Submarine Propagation Channel Assessment and Prediction (subPCAP): - Specific effort will include algorithm maturation and building prototype software to incorporate observed and predicted atmospheric conditions, especially in the immediate air-ocean boundary layer, into a submarine's passive radio frequency (RF) sensor assessment. System for Non-Acoustic Control of Signatures (SNACS): - This effort will complete with vendor fabrication and delivery of six prototype radar camouflage units (RCU) to the Navy for mechanical, environmental and signature performance testing. Stern Area System: - This effort will initiate the first at-sea trial test series to evaluate system performance and begin testing and analysis. Trial data will be analyzed to inform system updates and preparations for FY 2022 trials which will complete testing and evaluation. System dock-side testing and shipbuilder trials will be completed in FY 2021 to confirm system installation and function to complete ship Post Shakedown Availability (PSA) period. Avalanche: - Continue activity on Unmanned Underwater Vehicle persistence and infrastructure. The specific effort will involve the development and maturation of technologies for autonomous, non-wet, mateable-transfer of energy and data in support of long endurance missions for unmanned undersea vehicles and seabed warfare. It will also include the development of long endurance autonomy and hardware solutions for fixed and deployable energy sources and heterogeneous communication networks.					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Compact Rapid Attack Weapon (CRAW) Upgrade: - This effort will continue the development of advanced ASW capability software and conduct in-water testing. It will also continue software and hardware modifications to enable integration with the host platform. During FY 2021, the ASW capability software baseline development and performance validation will occur. Diver Augmented Vision Display with Enhanced Communications (DAVD): - Further develop augmented and mixed reality interfaces for divers as well as software that provides top-down, real-time view of diver's environment for navigation and location of targets. Further develop telemetry system that a diver uses to enable communication and control of Remotely Operated Underwater Vehicle. Advanced Broadband Navigation Sonar System (ABNSS): - Continue 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. Electronic Warfare Micro-Adaptive Trainer (EW-MAT): - Complete the advanced technology development of a submarine Electronic Warfare training capability that combines a digital RF simulation generator and a micro-adaptive training engine that emulates one-on-one human tutoring experience by adjusting instruction to target individual trainee needs. VIRGINIA Improved Propulsion Bearing (VIPB) - Initiate development of an improved propulsor bearing to be demonstrated on a VIRGINIA Class submarine in order to reduce the risk of introducing the bearing on the new COLUMBIA Class submarine. Submarine Tethered Expendable Buoy - Initiate development of a free-floating, tethered buoy for Intelligence, Surveillance and Reconnaissance (ISR) data collection and satellite communications in order to improve submarine stealth. ***FY 2021 OCO Plans:*** N/A ***FY 2020 to FY 2021 Increase/Decrease Statement:***					

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy		Date: February 2020
Appropriation/Budget Activity 1319 / 3	**R-1 Program Element (Number/Name)** PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	**Project (Number/Name)** 3346 / *Future Naval Capabilities Adv Tech Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
No significant change from FY2020 to FY2021.					
Accomplishments/Planned Programs Subtotals	203.391	221.277	246.054	0.000	246.054

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Navy			Date: February 2020
Appropriation/Budget Activity 1319 / 3	R-1 Program Element (Number/Name) PE 0603673N / *Future Naval Capabilities Advanced Tech Dev*	Project (Number/Name) 9999 / *Congressional Adds*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
9999: *Congressional Adds*	0.000	7.240	1.200	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.440

A. Mission Description and Budget Item Justification

Congressional Interest Items not included in other projects

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020
Congressional Add: Advanced Development of High Yield Conventional Energetics ***FY 2019 Accomplishments:*** FY19 funds will be applied to the advanced demonstration of energetic materials in a variety of weapon system applications to include: high performance solid rocket and air breathing propulsion, reactive materials demonstrations and effects in advanced lethality, effectiveness models, advanced warhead concepts to include novel reactive shaped charge configurations, hybrid reactive material warhead demonstrations, and the development and demonstration of any necessary modeling and simulation capabilities for quantification of damage effects on adversary weapon systems,and other potential energetic technologies. ***FY 2020 Plans:*** N/A	7.240	0.000
Congressional Add: Automated critical care system ***FY 2019 Accomplishments:*** N/A ***FY 2020 Plans:*** Conduct advanced technology development for Automated critical care systems	0.000	1.200
Congressional Adds Subtotals	7.240	1.200

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A