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THE HOUSE ARMED SERVICES COMMITTEE
SUBCOMMITTEE ON SEAPOWER AND PROJECTION FORCES

STATEMENT OF

FREDRICK J. STEFANY
ACTING ASSISTANT SECRETARY OF THE NAVY FOR
RESEARCH, DEVELOPMENT AND ACQUISITION (ASN (RD&A))

AND

VICE ADMIRAL JAMES W. KILBY
DEPUTY CHIEF OF NAVAL OPERATIONS
FOR WARFARE SYSTEMS

AND

LIEUTENANT GENERAL ERIC M. SMITH
DEPUTY COMMANDANT
COMBAT DEVELOPMENT AND INTEGRATION &
COMMANDING GENERAL, MARINE CORPS COMBAT DEVELOPMENT COMMAND

BEFORE THE

HOUSE ARMED SERVICES COMMITTEE
SUBCOMMITTEE ON SEAPOWER AND PROJECTION FORCES

ON

DEPARTMENT OF THE NAVY UNMANNED SYSTEMS

MARCH 18, 2021

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SUBCOMMITTEE ON SEAPOWER AND PROJECTION FORCES

Chairman Courtney, Ranking Member Wittman, and distinguished members of the subcommittee, thank you for this opportunity to appear before you today to address the Department of Navy's Unmanned Systems.

A dominant naval force and strong maritime strategy remain the primary engines of our National Defense Strategy. Delivering a Navy ready to control the seas and project power across all domains now and into the future requires us to balance current operational demands, the urgent need for modernization, and the imperative of future readiness. The developing abilities of near-peer competitors drive the need for increased naval capability distributed over a wider area. In order to meet the challenges of the future and align with strategic goals defined in the Tri-Service Maritime Strategy, the CNO's Navigation Plan, and the Commandant's Planning Guidance, the Navy and Marine Corps must innovate and accelerate delivery of credible and reliable unmanned systems in conjunction with increasingly capable manned platforms into the fleet.

Unmanned systems will create fundamental shifts in the way the Department of Navy (DON) conducts naval operations. Integration of unmanned and autonomous capabilities —under, on, and above the sea—offer many advantages, such as increased persistence and range, and improving the speed and accuracy of data processing, which supports a faster decision cycle while decreasing the overall risk to personnel. Furthermore, moving toward smaller platforms improves our offensive punch while also providing affordable solutions to grow the Navy. Through analysis, simulations, prototyping, and demonstrations, the DON will systematically field and operate systems that possess the endurance and resilience to operate with infrequent human interaction, allowing unmanned and autonomous technologies to become a powerful and ubiquitous force multiplier that far exceeds the effectiveness of platforms or humans alone.

The DON is taking a deliberate and disciplined approach to furthering these capabilities, investing time and resources by conducting a thorough review of our Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities and Policy (DOTmLPF-P) in order to systematically pursue this very relevant technology.

WHY UNMANNED? --- Technologies that enable adversaries to threaten our naval forces at greater ranges complicate our ability to access and maneuver within the maritime commons. In response to rapidly evolving technology capabilities of potential adversaries, the DON is creating a fully integrated manned and unmanned fleet based, not only on

mature technologies, but also on successful prototyping and experimentation with nascent unmanned related technologies that will enable asymmetric and tactical advantages.

Today's naval forces are beginning to integrate unmanned systems into operational forces across all domains. These efforts will enable new Concepts of Operations (CONOPS), and will drive the advancement of human-machine teaming by incorporating unique and disruptive capabilities that only unmanned systems can provide. Over the next several years, the DON will modify its DOTmLPF-P to provide the necessary ecosystem required to support these emergent capabilities and ensure that we continue to maintain maritime superiority for the foreseeable future.

UNMANNED CAMPAIGN PLAN --- The Unmanned Campaign Plan is a collaboration among the Navy and Marine Corps, based on key operational challenges, which aligns vision, strategy, requirements, resources, acquisition and supporting policies to execute unmanned opportunities. The Campaign Plan will serve as the comprehensive strategy for building and sustaining a future force where unmanned systems take on an increased role in delivering lethal and non-lethal effects simultaneously in all domains across multiple axes. This living document will help shape the future of both Navy and Marine Corp capabilities, guide our naval research and development establishment on investments, and through the acquisition process, develop deeper understanding of and integration with industry. Through early and consistent planning with allies and rigorous testing, the DON will accelerate, deliver, and scale valuable manned/unmanned capabilities.

SYSTEMATIC APPROACH --- By using proven methods of systems engineering and technology exploitation as our framework, the DON will reduce risk while improving fleet integration efficacy. Collaboration by our laboratories, academia and industry partners, fueled by a balanced mix of land and sea-based prototyping, will accelerate the "build a little - test a little - learn a lot" process for these technologies, as well as provide feedback and lessons learned from experiments and exercises to assist CONOPS development. This framework includes applying a digitally based, modular open systems approach to ensure major systems and interfaces use recognized standards as broadly as possible. Such an approach will help manage complexity, improve flexibility and upgradeability, and provide options as new challenges arise. In addition, the establishment of a Cybersecurity Technical Domain for Ships that can perform cyber testing ashore and afloat during Engineering and Manufacturing Development, Developmental Testing, and Operational Testing phases will

reduce cyber risk earlier in the schedule.

In accordance with provisions in the Fiscal Year (FY) 2020 National Defense Authorization Act, the DON has assigned Senior Technical Authorities (STAs) to our unmanned surface vessels (USVs) and unmanned undersea vehicles (UUVs). These STAs are responsible for, and have the authority to, establish, monitor, and approve technical standards, tools, and processes for these new unmanned class of naval vessels. STAs will engage throughout the entire acquisition lifecycle; approve or concur with related acquisition artifacts, including Systems Engineering Plans, Independent Technical Risk Assessments, Acquisition Strategies, and Test and Evaluation Master Plans; and be involved in Gate and Milestone Reviews.

ENABLERS AND STANDARDS --- Among a core set of critical technology enablers – including endurance, payloads and sensors, platform integration, and command, control and communications – autonomy is the linchpin to unlocking the potential for the Navy's future manned and unmanned maritime vehicle fleets to execute missions successfully, and reliably navigate for days, weeks or even months. Given its significance to the future capability enhancement and expansion of both USVs and UUVs, the DON's acquisition community intends to speed autonomy development by leveraging our science and technology investments, aggressively applying standards and interfaces, and leveraging commercial best practices for software development, data management, and machine learning.

The first piece of the process is the development of the Unmanned Maritime Autonomy Architecture (UMAA), which lays out a set of standards to support the development of common core autonomy capabilities, thus enabling programs to leverage these common software capabilities across differing vehicle and mission types. UMAA standardizes the interfaces between software components thus providing the basis for practical software reuse on multiple programs and vehicles without paying multiple vendors to develop the same software for different platforms and different environments.

The Rapid Autonomy Integration Lab (RAIL) is the next step forward in executing the Navy's vision for development and deployment of unmanned system capability. The concept leverages on-going autonomy standardization efforts and deployment of the Common Control System (CCS) across the maritime unmanned platforms. The RAIL provides the digital engineering infrastructure, tools, and processes to rapidly develop, test,

certify, and deploy new and updated autonomous capabilities to those vehicles by implementing modern software development best practices. The guidance is intended to de-couple the platforms hardware and software to enable the RAIL to build up a library of certified and re-usable code and processes, and serve as a source of data and validated modeling and simulation tools for industry partners.

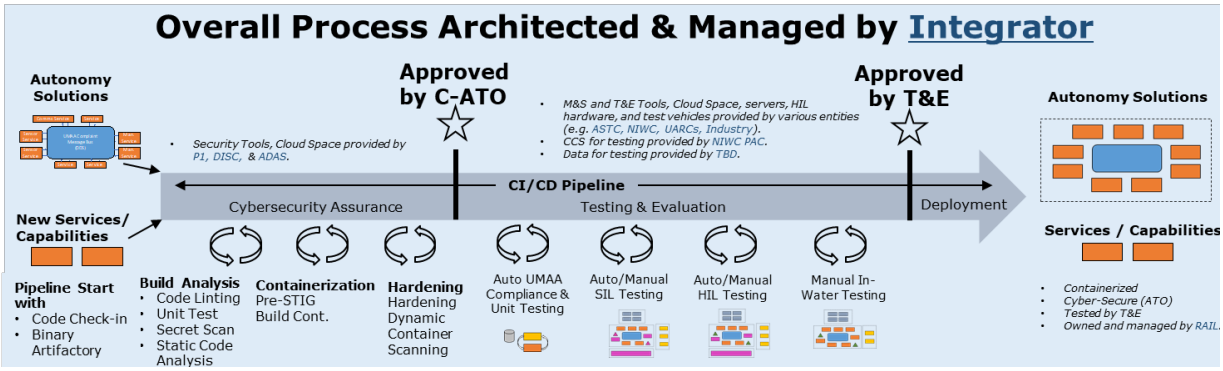


Figure 1: Pipeline Overview

Pipeline overview: UMAA is intended to allow for the modular (micro services) upgrades of new autonomous capabilities into UUV's and USVs. As new software is introduced into the RAIL, the pipeline can be broken into two main segments that address information assurance (IA) and autonomy performance.

LAND BASED TEST SITE --- In keeping with standardizing and ensuring technology maturity and reliability for our Medium Unmanned Surface Vehicle (MUSV) prototype, the Navy is working to establish a land based test site to augment our sea based testing. In accordance with the FY 2021 National Defense Authorization Act, this facility will be outfitted with main propulsion and electrical systems, and will help validate the USV equipment/system reliability qualification process that we are establishing for commercial based capabilities.

COMMON CONTROL SYSTEM (CCS) --- Our current CCS program is working across multiple domains and multiple platforms to bring a Model-Based Systems Engineering approach, with full government data rights, to drive unmanned air systems (UAS) control system commonality and reduce the barriers to unmanned system interoperability. Through the alignment of standards, CCS supports multiple surface/undersea warfare efforts and plans for a long-term combined Software Support Activity are ongoing.

DISTRIBUTED NETWORKS --- To support a future fleet of manned and unmanned vessels the DON is developing a warfighting network of networks via Project Overmatch—a

communications network connected by manned and unmanned nodes. This architecture is designed to establish nodes in all domains of the battle space and, in some cases, across domains as conduits for multi-domain communications. Nodes must be seamlessly interconnected, self-healing, and highly survivable to enable a high fidelity common operational picture, allowing better situational awareness for the commanders and fighting forces. This architecture will fuse big data, interpret the rapidly changing environment, share relevant information across the network, and inject increased risk, uncertainty, and doubt in the adversary's battlespace.

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING ---The DON recognizes the need to increase investments in Artificial Intelligence (AI) and Machine Learning (ML) in order to provide our Naval forces cognitive and mission advantage and enable development of intelligent systems. AI/ML evolution is increasing on a global scale with rapid advancements in enabling technologies and applications. Increased research in understanding and using big data and related decision support tools will help fuel analytic processing and establish patterns of life to inform the development of predictive models.

The DON is working to develop an autonomy-literate workforce, and increase R&D in natural language processing to accelerate and enhance human-machine collaboration. Interfaces with our unmanned systems will evolve to reduce opportunities for error and increase understanding and mission efficiency. In addition to increasing AI and ML based capabilities, the DON is also working to foster counter-AI capabilities to protect against adversarial AI systems and ensure resilient operation of our own. Increased processing with machine learning will improve decision speed in time-critical operations and enable our unmanned systems to perform at mission speeds beyond human capacity.

The landscape of AI development and potential is vast and the DON recognizes that we must plan to smartly leverage, not duplicate, the investments made by U.S. commercial interests while smartly shaping development and investment in Navy-unique AI applications.

LOGISTICS --- The DON is keenly aware that unmanned systems can help provide persistent supply, support, and sustainment. Designing unmanned systems and enabling technologies to provide effective and efficient logistics support is necessary. This will include platforms, payloads, sensors, information systems, and infrastructure for readiness reporting and forecasting, supply, and maintenance diagnostics capable of supporting operations in hostile and denied environments.

The Marine Corps is pursuing unmanned capabilities and technologies as part of a more holistic approach to modernize their distribution networks to make them more intelligent and data driven. At present, organic to the Logistics Combat Element/Ground Combat Element the Marine Corps envisions medium sized unmanned logistic UASs that are capable of distributing loads out to the squad level. This includes smaller UAS payloads of approximately 50-300 lbs. For these, we are currently in developmental testing and experimentation with Army Research, Development and Engineering Command, the Office of Naval Research, and the Marine Corps Warfighting Laboratory. We are working with the Army to develop a Joint CONOP for medium unmanned logistic system payloads of approximately 300-800 lbs.

TEST AND EVALUATION --- The Navy has successfully integrated developmental and operational testing of unmanned systems into normal business processes across the acquisition enterprise. DON Operational Test Agencies are fully engaged with the acquisition programs and technology development from inception to understand the tasks each system will be responsible for performing and the system's operating environment. This information will inform the development and execution of an Operational Test and Evaluation Plan that supports acquisition and fielding decisions, as well as informing fleet tactics, techniques, and procedures (TTPs), capabilities and limitations. The Navy's new Capability Based Test and Evaluation approach will integrate the data generated throughout the unmanned system development and provides an operational mission impact statement to every deficiency discovered. This will allow a program manager to make timely data-driven decisions and prioritize efforts to expedite capability delivery.

UAS developmental testing efforts are primarily conducted out of Naval Air Station (NAS) Patuxent River, Maryland. In addition to the general test support provided to typical programs of record, the DON has established a dedicated developmental test squadron to address the smaller Group 1 through 4 UAS. Lessons learned and best practices are shared across the various programs offices, squadrons, and base testing facilities, which accelerates testing activities and reduces costs. The Navy is developing a ground-based fixed site sense-and-avoid system to support testing at NAS Patuxent River to achieve safe separation between an unmanned aircraft and other aircraft. Additionally, the Navy is partnering with OSD and the other Services to develop and field a mobile sense-and-avoid system to expand current testing capabilities and to address joint testing gaps.

UUVs are being developed and tested at numerous ranges on both coasts, from the Bahama's Atlantic Undersea Test and Evaluation Center to Newport to SCORE in San Diego and Dabob in Puget Sound. To a great extent, the existing ranges have provided the capability and capacity to support the characterization of system navigation and mission performance. The Navy is investigating the ability to leverage existing undersea modeling and simulation capabilities to accelerate development and reduce costs. For example, we have shown that substantial investments in the fidelity of the Weapons Analysis Facility at NSWC Newport ocean and target modeling has resulted in the ability to reduce required open water torpedo runs by 25 percent and accelerate the test schedule. The Navy will use this same approach with UUVs to identify opportunities to leverage existing capabilities to expedite testing and deliver this needed warfighting capability to the fleet as fast as possible. Similarly, our USV development efforts will be supported by existing range facilities on both coasts, but we continue to seek out opportunities to optimize test strategies and schedules.

MAJOR EXPERIMENTS --- The Navy and Marine Corps are conducting a variety of experimentations with unmanned systems in FY 2021 that include: the Pacific Fleet's Integrated Fleet Battle Problem 21, which will focus on maneuver in a contested space using manned/unmanned teaming in all domains; Trident Warrior, which will focus on employing air, surface and undersea systems from a LPD; Large Scale Exercise 2021, which will demonstrate surface connector autonomy in support of Expeditionary Advanced Base Operations and inform Marine Littoral Regiment / Future Infantry Battalion CONOPs/CONEMPs/TTPs; and Naval Integrated Live Virtual Constructive Environment and Distributed Experimentation Environment which use modeling and simulation tools to represent LRUSV, Organic Precision Fires, and the MQ-9A in order to evaluate possible messaging between the domains.

All of these efforts remain critical in facilitating how we can learn to shift the risk from our human operators to our unmanned systems while driving down the technical risks associated with developing and integrating new technology.

TRAINING --- Investments in Fleet manning, training, doctrinal development, and experimentation continue to evolve as these new technologies take shape and begin their integration into the fleet. Facilities must keep pace with the expanding role of unmanned systems in the Fleet. Without these investments, the employment of these systems will

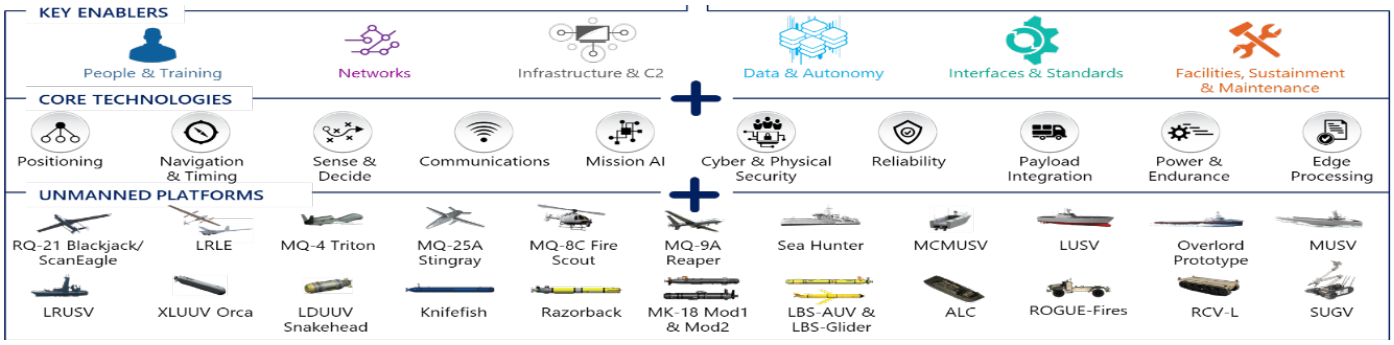
never reach full potential. As training and support concepts are established for individual systems, areas of commonality in training and sustainment will be identified and assessed for future application.

The DON is looking at ways to maintain proficiency of a growing cadre of active component personnel trained in unmanned systems operator and maintainer skills. This will include defined career paths with opportunities for professional advancement. In addition, as unmanned systems begin to be fielded in wider applications and in more complex environments, the DON will increase emphasis on use of AI/ML skills, simulators and synthetic training tools to complement in-water testing, evaluation and system updates to create a more responsive and agile Navy.

CONCLUSION --- As our Nation faces the inevitability of adversaries in the future who employ the advancements in autonomy, artificial intelligence, hypersonics and unmanned systems, we need to fully understand and exploit the benefits of manned/unmanned command and control in our fleet architecture to counter this threat. Unmanned and autonomous technologies coupled with our tactical networks will become a powerful and ubiquitous force multiplier in an integrated human-machine team. The combination will provide capabilities that far exceed the effectiveness of platforms or humans alone. Employment of manned/unmanned teams and technologies will transform modern warfare, increasing asymmetric operations, leveraging the technologies to the DON's advantage, giving the warfighter the edge to win the fight.

Additional details on the DON's current unmanned platforms and projects are below.

CURRENT PLATFORMS/PROJECTS --- The Navy and Marine Corps' strategy for unmanned systems includes operating in the air, on the surface, under the sea, and ashore as a rapidly adaptable and interconnected network that will provide access to far-forward areas denied to manned platforms, provide better situational awareness, increase capabilities with greater range and persistence, and enable faster decision making than the adversary. This improved battlespace awareness will afford the Navy and Marine Corps the ability to disrupt the enemy's order of battle, engagement strategies and operational tactics to minimize any theater advantages that could jeopardize our Sailors or Marines.



AIR --- Consistent with Distributed Maritime Operations, Naval Aviation fully supports the continued integration of unmanned systems into the Fleet to enable a fundamental shift in the way the DON conducts naval aviation operations. Advantages for continuing and broadening unmanned aviation efforts include decreased risk to personnel, greater persistence, longer ranges, improved data speed and accuracy, and a faster decision cycle. These capabilities offer the DON increased asymmetric operational opportunities and tactical advantages that provide the warfighters an edge to dominate and win in ongoing and future conflicts.

Naval Aviation has already deployed a variety of UAS to the Combatant Commanders. For example, MQ-4C and MQ-8B/C UASs are deployed and in operation with the Navy and RQ-21 'Blackjack', Scan-Eagle and other Group 5 UASs are deployed and in operation with the Marine Corps. We continue to mature the concept of employment of these systems as we fly, integrate and increase quantities into the Navy/Marine Corps Fleet. Of note, reliability, maintainability and availability of UASs are comparable to manned platforms, and we continue to collaborate with our industry partners to increase readiness and lower overall sustainment costs.

Naval Aviation is continuing the development of new unmanned aviation capabilities. The MQ-25 UAS will provide a critical organic aerial refueling capability to the Carrier Air Wing (CVW) and extend the CVW mission effectiveness range, increase the number of F/A-18E/Fs available for the strike fighter mission by relieving F/A-18E/Fs from the refueling mission, and mitigate future strike fighter and organic CVW Intelligence, Surveillance and Reconnaissance (ISR) shortfalls.

As part of a two-phase strategy for future Marine UAS, the Marine Corps will procure, upgrade and deploy MQ-9 unmanned systems from land bases to expand our expeditionary airborne data relay and C4ISR capabilities. Of note, MQ-9 is already in

operation by both the U.S. Air Force and Marine Corps and will reduce the overall investment and sustainment requirement to provide the Expeditionary Strike Group and "Marines on the Ground" a more capable and persistent capability. As part of the second phase, the Marine Corps is exploring a long-range, high-endurance Marine Corps UAS for future operations.

Manned/unmanned teaming development efforts currently underway include the development of CONOPS/Concepts of Employment (CONEMPS) for integrated operations of and development of a common control architectures and common standard interfaces and protocols. MQ-25 is currently leading many of our current manned/unmanned teaming efforts via the development and maturation of complex sea-based C4I UAS technologies and software algorithms that pave the way for future multi-mission UASs to keep pace with emerging threats. Towards that end, we also envision MQ-4C teaming with P-8A and MQ-8C teaming with MH-60S rotary-wing platforms.

Naval Aviation unmanned programs are proceeding on a steady course and speed. The DON has successfully developed/employed a number of new unmanned technologies and systems, observed the operational benefits of UASs in not only combat but also drug interdiction, logistics, and day-to-day operations. We see a future where further investment and maturation in unmanned air system is not only practical – but essential towards addressing the Nation's current and future threats and needs.

UNDERSEA --- The Navy is developing a family of unmanned undersea systems and vehicles capable of delivering effects that have operational agility and versatility from beneath the surface, increasing far forward operational persistence, and enabling clandestine surveillance and combat reach. UUVs are a key component of this effort, and will operate independently from, or in cooperation with, manned vehicles; operate in areas that are inaccessible to manned submarines and ships; and address the capability gaps such as extended range ISR/ Intelligence Preparation of the Operating Environment (IPOE) missions, Anti-Submarine Warfare (ASW), Anti Surface Warfare, Electronic Warfare (EW), Mine Warfare (MIW), Strike, and Deception operations.

Since the undersea domain is varied and poses a myriad of challenges, a "one size fits all" solution is insufficient, and requires a family of small, medium, large and extra-large vehicles. The Navy is committed to growing both the size and composition of the UUV force.

Orca is the Navy's Extra Large UUV (XLUUV) that is designed to be pier launched and operate at sea for months at a time. It is based off Boeing's Echo Voyager, but incorporates significant changes to support military mission requirements. This has resulted in challenges in establishing the manufacturing process, building up the industrial base, and aligning material purchases to produce the first group of prototype vehicles. Orca represents the leading edge of autonomous maritime vehicle technology and will have extended range and a reconfigurable, modular payload bay to support multiple payloads and a variety of missions.

Snakehead is the Navy's Large Displacement UUV designed to perform deep missions for long-durations, freeing manned platforms for higher priority tasking. Snakehead's initial mission will be IPOE, but the vehicle is reconfigurable to host several payloads intended to pace the threat and advancements in technology. One Phase 1 vehicle is being fabricated for integration onto Dry Deck Shelter (DDS) equipped submarines. Phase 2 will be a competitive award to industry, with increased capabilities and integration onto future large ocean interface equipped submarines.

Small and Medium Unmanned Undersea Vehicles (SUUV and MUUV) - The Navy has a portfolio of small and medium sized UUVs including Littoral Battlespace Sensing - Autonomous Undersea Vehicles (LBS-AUVs), LBS-Gliders, Razorback, Mk18 Mod 1 and 2 UUVs, and Knifefish.

LBS-AUVs and LBS-Gliders provide battlespace awareness by collecting oceanographic data to include conductivity, temperature, depth, optical clarity, side-scan sonar imagery, and high resolution bathymetry in support of ASW/MIW, IPOE, and Safety of Navigation. LBS-AUVs are operated by civilians from the Naval Oceanographic Office and are primarily hosted on T-AGS 60 Pathfinder Class Multi-Mission Oceanographic ships.

Razorback is an MUUV with two deployment configurations, DDS and Torpedo Tube Launch and Recovery (TTL&R). The DDS Variant is supported by diver-assisted launch, while the Razorback TTL&R Variant is submarine torpedo tube launched and recovered. Initial Razorback UUV missions include IPOE and ISR. Future missions may involve a wide-range of mission sets. Razorback host platforms are submarines.

Navy Expeditionary forces continue to operate a family of unmanned underwater vehicles for mine countermeasures and to address known capability gaps since first used in

2003 during Operation Iraqi Freedom in Umm Qasr. Since that time they have been employed in areas of operations across the globe - from New Caledonia to Korea to the North Sea to the Baltic - and many areas in between. Expeditionary UUVs have been in continuous deployment in the CENTCOM Area of Responsibility supporting U.S. Fifth Fleet Mine Countermeasures (MCM) operations since July 2012.

The MK 18 Family of Systems (FoS) operate in the fleet today. This FoS includes the MK18 Mod 1 Swordfish (a Small UUV) and the MK18 Mod 2 Kingfish (a Medium UUV). Both the Mod 1 and Mod 2 UUVs are capable of performing low-visibility exploratory and reconnaissance missions, MCM (including detection, classification, reacquisition and identification of mines or unexploded ordnance), rapid object localization, and environmental data collection surveys, including hydrographic mapping. The UUVs offer Sailors faster post-mission analysis using operator-aided automated target recognition. The man-portable Swordfish excels in Very Shallow Water operations and the seaward approaches, while the larger Kingfish extends this capability into Deep Water with an improved endurance and area coverage rate. The Kingfish UUV is uniquely modular, allowing operators to easily reconfigure the vehicle with various SONAR and sensor payloads to address the threat or mission at hand. Both UUVs can be launched from small boats and are integrated into the 11-meter RHIB for expeditionary MCM operations. Swordfish is deployed to U.S. Fifth Fleet and U.S. Seventh Fleet for operational use; Kingfish is currently deployed to U.S. Fifth Fleet and has been tested and validated in U.S. Seventh Fleet.

Knifefish (an MUUV) is being procured to detect, classify, and identify bottom, buried, and volume mines, as well as conduct IPOE. Knifefish achieved Milestone C and low rate production in 2019, and will commence testing with its recent government accepted Block 0 assets in FY 2021. Feedback from the fleet during the Operational Assessment and updated target threats identified the gaps that needed to be filled in order to field an upgraded Block 1. Knifefish will achieve Initial Operational Capability with Block 1 as early as 3rd Quarter FY 2022.

The UUV FoS will require continued investments in the undersea infrastructure and UUV core technologies, which include endurance, autonomy, precision navigation, communications, command and control, payloads and sensors, and platform integration (i.e., launch and recovery).

SURFACE --- The DON is developing modular and capable force multiplying unmanned surface systems that significantly increase the standoff, reach, and protection of our manned platforms. The Future Surface Combatant Force (FSCF) Analysis of Alternatives (AoA) and the JROC-approved FSCF Initial Capabilities Document highlight the role of the MUSV and Large USV (LUSV) in the future hybrid fleet that also includes small and large (manned) surface combatants. These unmanned surface systems will be employed individually, deployed as surrogates, and teamed with manned platforms to achieve surface dominance as outlined in the initial USV CONOPS document completed by the Surface Development Squadron in January 2021.

As directed in the FY 2021 National Defense Authorization Act, the Navy is conducting a Distributed Offensive Surface Fires AoA to compare the currently planned LUSV with an integrated missile launcher payload against a broad range of alternative surface platforms and capabilities to determine the most appropriate vessel to deliver additional missile capability and capacity to the surface force. We expect to complete this analysis and report our findings to Congress before the end of this calendar year.

Building upon the Department of Defense's Strategic Capabilities Office (SCO) funded and Navy executed experimentation with USVs in Project Overlord, the Navy's LUSV will be a high-endurance vessel based on commercial specifications, capable of weeks-long deployments and trans-oceanic transits. With a large payload capacity, the LUSV will be designed to conduct a variety of warfare operations initially in conjunction with manned surface combatants while under the positive control of a man-in-the-loop for employment of weapons systems.

The Navy is taking an iterative, systems engineering approach to obtaining this technology and has designed an integration and experimentation plan that will validate high reliability mechanical and electrical systems, autonomous navigation and maneuvering, integration of combat system, and platform command and control capabilities prior to employment opportunities.

LUSV Design Studies contracts were awarded in September 2020 to six Industry teams to provide robust collaboration with government and industry to assist in maturation of platform specifications, and ensure achievable technical requirements are in place for a follow on development contract. Both Industry and the Navy are using these collaborative interactions to significantly advance the knowledge base that will feed into the LUSV program.

MUSV is an unmanned sensor-ship, built to carry modular payloads, and standardized for easy integration with current Navy systems. Inexpensive compared to manned combatants, they can be built in numbers, quickly adding capacity to the Fleet. MUSV delivers a distributed sensor network that can navigate and operate with man in/on the loop oversight, and will be capable of weeks-long deployments and trans-oceanic transits. The Navy awarded a design and fabrication contract to L3Harris to develop the first MUSV prototype in accordance with Interim Top Level Requirements approved in 2019. The MUSV prototype is targeted for delivery in FY 2023.

The Navy has benefited through its prototyping and experimenting with Sea Hunter and Overlord unmanned surface vessel prototypes accumulating over 3,100 hours of autonomous operations to include teaming with other manned ships. The Navy will continue experimentation and reliability demonstration efforts in FY 2021 and FY 2022 on the two SCO-funded Overlord vessels as ownership shifts to the Navy. The Navy is also building two additional Overlord prototypes that will deliver in FY 2023 to support continued experimentation, and future mission CONOPS. The DON is evaluating other Distributed Maritime Operations applications to include logistics supply and refueling, Marine Corps expeditionary options, and enhancements to other surface platform missions (e.g. anti-submarine warfare, ballistic missile defense). As part of this evaluation, the Navy is collaborating with Military Sealift Command and the Marine Corps to modify a T-EPF with autonomy. This will help accelerate gathering more autonomy knowledge and reliability on another class of ship equipped with V-22 landing capability, a large logistic and personnel Size, Weight and Power capability, and ability to operate at high speeds.

MCM USV program is development and production of MCM USV craft (small USV) and Payload Delivery Systems to meet MCM Mission Package requirements. It leverages the mature craft and sweep payload developed for the Unmanned Influence Sweep System program that achieved MS C and Low Rate Production in FY 2020. Mine hunting payload integration (with the AN/AQS-20 towed sonar) is in progress and mine neutralizing payload integration is beginning development (with the Barracuda program)

USVs in the fleet today include the Mine Hunting Unit (MHU). The MHU consists of a USV craft integrated with the AN/AQS-24B sonar system, which provides day/night at-sea minehunting capability. MHUs provide Mine Warfare Commanders with a stand-off, long-endurance, unmanned, semi-autonomous minehunting capability. MHUs possess

bottom mine and volume mine detection and classification capabilities for shallow regions, and limited volume mine detection, and classification in deep regions. Shallow and deep channel operations include designated ingress and egress routes for port facilities, straits, and choke points, and approaches to amphibious operating area transport and patrol areas. MHU was developed in response to an Urgent Operational Need, and four have been delivered to support MCM operations in U.S. Fifth Fleet. Follow-on capabilities are projected to be filled by the Navy's MCM USV Program.

Long Range Unmanned Surface Vessel (LRUSV) is a new capability that provides the Marine Corps with a system that increases the lethality of the Naval Force to defeat peer competitors in support of the National Defense Strategy. The current LRUSV initiative is focused on developing an unmanned platform which is capable of traveling semi-autonomously and transporting loitering munitions to address sea and land targets. This platform, coupled with advanced Command and Control and targeting capabilities, will result in a long-range precision fires system that complements future Navy and Marine Corps operational concepts in support of Force Design 2030.

GROUND --- Recognizing the need for increased long-range precision fire capability, the Marine Corps envisions the Navy and Marine Corps Expeditionary Ship Interdiction System (NMESIS) as a new asset against peer adversaries. As the initial materiel solution for a Ground Based Anti-Ship Missile (GBASM) capability, NMESIS fires a Naval Strike Missile using a launcher and fire control system integrated on a ground-based, remotely operated platform, called ROGUE-Fires. The Marine Corps is uniquely suited to contribute ground based anti-ship systems into the fight as a component of the Naval Force, and NMESIS is the key lethality component of the future Marine Littoral Regiment to facilitate sea denial in support of the Fleet and Joint operations.