STATEMENT OF

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BEFORE THE

CYBER, INNOVATIVE TECHNOLOGIES AND INFORMATION SYSTEMS
SUBCOMMITTEE

OF THE

HOUSE ARMED SERVICES COMMITTEE

MAY 20, 2021

Introduction

Thank you for the opportunity to address the science and technology (S&T) investment strategy of the Department of the Navy (DON) and the Naval Research and Development Establishment. Since this nation's founding, the United States has depended on naval power to defend its shores and protect free and open ocean commons. As our nation grew, naval power has been enabled by innovation, skilled seamanship, courage, careful planning, and maintaining a technological edge. Today, as we face rapid change in the global security environment— including increased access to technological knowledge and attempts by potential adversaries to dominate emerging weapon technologies—the national security posture is adapting with a sense of urgency and innovation. The DON continues to emphasize acceleration and agility in everything we do to keep our technological advantage and to deliver capabilities faster than our adversaries.

Naval Research and Development Establishment (NR&DE)

As the Deputy Assistant Secretary of the Navy for Research, Development, Test and Engineering (RDT&E), I have responsibility for Naval R&D leadership, policy, and oversight as well as oversight for the technical missions of the naval labs. The NR&DE includes not only the Naval Warfare Centers (Air Warfare, Information Warfare, Surface Warfare, Undersea Warfare, Expeditionary Warfare), the Office of Naval Research (ONR) and the Naval Research Laboratory (NRL), but also now includes the Marine Corps Warfighting Laboratory (MCWL), the Naval Postgraduate School, University Affiliated Research Centers (UARCs) at University of Hawaii, University of Washington, University of Texas, Penn State University and Johns Hopkins University, and Federally Funded Research and Development Centers performing naval work. Providing unique value to the Navy and the nation, the NR&DE commits to innovate, collaborate, and deliver superior capability at the speed of relevance; to identify and develop robust, affordable technical solutions for readiness and modernization; and to apply continuous improvement to drive program success. The NR&DE cultivates unique, yet connected, learning ecosystems that ideate and produce creative solutions critical to enabling the rapid development, delivery, and sustainment of game-changing capabilities for the Navy and Marine Corps.

People

The NR&DE's strength lies in our people – they are our asymmetric advantage. Therefore, we must recruit, train, and retain a ready, relevant, diverse workforce comprised of scientists and engineers as well as business and administrative personnel to strengthen our technical advantage. The Naval Warfare Centers (WCs) and NRL employ a robust Capabilities Health Assessment methodology to identify the pipeline of professionals representing a broad spectrum of core competencies required to execute current and future mission priorities across the full-spectrum life cycle of weapons systems development and sustainment –from basic and applied research, to design and development, test and evaluation, and in-service engineering.

Over 35,000 scientists and engineers are part of the NR&DE. More than 28,000 of these technical professionals are civilian employees within the WCs and NRL, working seamlessly with nearly 7,700 professionals within the UARCs. Given the disruptions and opportunities exposed by COVID-19, we are exploring additional innovations to the future of work. One key area we are reimagining at this very moment is the Naval Science, Technology, Engineering & Math (STEM) program. The NR&DE workforce must reflect the diversity of American society. Through STEM opportunities and research networks to Historically Black Colleges and Universities /Minority Institutions (HBCU/MI), the NR&DE is working to attract talent previously underrepresented in S&T.

Diversity and equity are indispensable to the DON's success. The richness and breadth of ideas and solutions generated by a diverse workforce, collaborating in an environment where individual contributions are visible and valued, will enable the DON to reach its peak potential. In FY 2020, 35 percent of WC and NRL new hires were minorities (by Ethnicity and Race Indicator (ERI)). In the past four years (FY 2016-2020), the WCs and NRL have added more ERI minorities to the higher ranks (27 percent increase), as well as a 32 percent increase of females. To remain ahead, we must continue to modernize the NR&DE talent management framework through solid diversity, equity and inclusion efforts, employee satisfaction, retention, and succession planning. Thanks to the valuable legal authorities provided by Congress in hiring, pay, scholarships, contracting, and other areas of the Science and Technology Reinvention Laboratories (STRLs), the WCs and NRL continue to attract and retain key talent.

Capabilities

Flowing from the National Defense Strategy, to the Office of Secretary of Defense's Research and Engineering Modernization Priorities, the Chief of Naval Operations' Navigation Plan, and the Navy, Marine Corps, Coast Guard Tri-Service Maritime Strategy, our approach is to address technical risk in the Navy's future portfolio by conducting more warfighter informed prototyping, experimentation, and demonstrations. Many of the technologies that are available in the near term are enabled by five to fifteen years of basic and applied research. We are realizing successes today in Directed Energy, Unmanned Systems, Artificial Intelligence and Machine Learning (AI/ML), Microelectronics, Quantum Technologies, and Autonomy as a result of deliberate S&T investments prioritized over the past 20 years. To address near-term needs, we are applying critical thinking and agility, combined with sound systems engineering principles, to identify and implement new ways to use existing weapons systems to deliver different effects, thereby expanding warfighting capabilities at speed while reducing cost.

Autonomy

To support effective Distributed Maritime Operations (DMO), the NR&DE is expanding research and development efforts to develop, mature, and transition AI/ML technologies designed to enhance our ability to identify, predict, and respond to threats; and digital science modeling and simulation technologies to enhance analysis. As a necessary evolutionary response to the new warfighting paradigm, the NR&DE is working to re-envision unmanned systems as Intelligent Autonomous Systems (IAS). IAS are comprised of autonomy and its intersections with both unmanned systems and AI. Autonomous systems provide additional warfighting capability and capacity to augment our traditional combatant force, allowing the option to take on greater operational risk while maintaining a tactical and strategic advantage.

By exploiting the technical revolution in autonomy, advanced manufacturing, and artificial intelligence, the naval forces can create many new unmanned, optionally-manned, and minimally-manned platforms that can be employed in a distributed, networked manner. The IAS approach is particularly relevant in the maritime domain, where the battlespace spans from the seabed to space, and engagements occur across hundreds, even thousands of miles. The development and adoption of IAS is critical to the Navy and Marine Corps' ability to collect and sift the incredible amount of data required for modern warfare in the 21st Century.

Energy Resilience and Climate Change

The Navy and Marine Corps have placed additional emphasis on energy resilience and climate change in the R&D community. We develop naval forces that are capable of responding and handling the increased demand for the Navy's military and humanitarian services as well as overcoming future climate based impairments to deliver lethal capacity.

Seventy-five percent of naval energy and fuel use is operational, used by ships, aircraft, and combat vehicles deployed all over the world. In that context, we also develop capabilities that will reduce the amount of green-house gas emissions naval forces produce through more efficient use of energy. Weapons systems with increased range, longer time-on-station, and smaller logistics tail are central to a more lethal and capable naval force. A resilient ship is one that is more efficient, providing improved persistence on station with the same fuel use.

The Naval R&D community is developing technology that supports climate sensing and mitigation. ONR leads the science and technology development of environmental assessment and prediction as well as advanced energy technology development to adapt our future platforms and advance naval warfighting capability. In partnership with industry, many of the engineers in our WCs and NRL are striving daily to make our platforms more efficient whether developing stern flaps and integrated hybrid propulsion for ships, advanced batteries for unmanned underwater vehicles, or improving solar technology.

Digital Engineering

The DON embraces Digital Engineering as a means to maximize agility, interoperability, reusability, and scalability across the Navy. The Navy and Marine Corps Digital Systems Engineering Transformation Strategy, released in June 2020, specifies activities to enhance our engineering acquisition practices. Our strategy aligns with Department of Defense Digital Engineering Strategy goals, transforms how we support acquisition, and informs designers, developers, managers, and technical authority stakeholders with continuous access to authoritative data. It shifts the practice of systems engineering from traditional document-centric activities to digital-centric activities. It also supports common application across the Navy and Marine Corps, as well as provision and access to digital models and data applied in a Model-based Systems Engineering approach to improve the understanding, quality, consistency and

timely delivery of warfighter capability across all domains, and across all stages of the program lifecycle.

We have established an Integrated Modeling Environment (IME), possessing a suite of Model-Based Systems Engineering (MBSE) tools available to users, programs, and our engineering communities, hosted at the Naval Air Systems Command. Since its inception in 2019, we have grown to over 1,400 IME users, and 1 million hours of cumulative use (as of May 2021). We have also conducted MBSE training sessions for over 7,500 engineering professionals, who are applying those new skills to support the development and acquisition of new systems. We continue to expand our efforts, working with our industry partners to provide a standard of practice that delivers affordable, lethal capabilities to the warfighter at the speed of relevance. Our plans include connecting the IME to the Department of Navy High Performance Computing Network. This will provide potential for "digital threads" of information to be conveyed and used for physic-based models, architectural models, digital testing, digital twins, and data analytics supporting decision-making across the life cycle of programs from inception to development, production, and sustainment.

Project Overmatch

As stated in the CNO's NAVPLAN, our operating concepts require platforms, weapons and sensors to be connected in order to successfully execute Integrated All-Domain actions from a distribute and forward deployed force, as envisioned with the Navy's DMO concept. The success of DMO and the Marine Corps' Expeditionary Advanced Base Operations / Littoral Operations in a Contested Environment concepts is dependent on a robust Naval Operational Architecture (NOA), which also enables naval forces to integrate with the Joint Force for Joint All-Domain Command and Control. Project Overmatch focuses existing efforts and NR&DE expertise to field the NOA in this decade. Overmatch will develop networks, infrastructure, data architecture, tools, and analytics that support the operational and developmental environments that enable warfighter centered design and rapid capability delivery. The NR&DE is the primary engine of technical expertise behind the Overmatch driven NOA capability development, particularly in the technology areas of software defined networking and modern software development practices that enable more seamless digital integration of disparate, distributed systems.

Directed Energy

Directed Energy (DE) weapons will be essential to countering urgent threats from our nation's adversaries. Sustained investment in basic research has allowed the U.S. to remain at the forefront of DE weapons development. The products resulting from basic research - conducted by the NR&DE, commercial firms, and academia - form the foundation of present-day directed energy systems and will enable the next-generation of systems. The Department's investment in DE began in the 1990s in exploring high energy laser technologies and architectures as well as the related issues of high power optics, atmospheric propagation, and effects of lasers on targets. Although it takes years for science to transition to a deployable system, without that fundamental research we are assured that the U.S. would have lost its global technological edge.

Delivering At the Speed of Relevance

Advanced Naval Technology Exercises (ANTX)

Advanced Naval Technology Exercises (ANTX) are designed to identify technologies that can be transitioned to the warfighter within 12 to 18 months. Through the collaboration of industry, academia, and government R&D organizations, ANTXs provide an environment for the warfighter to assess the operational utility of technical innovations as well as a forum for informational exchanges and risk reductions for larger Fleet and Marine Corps exercises. Most importantly, an ANTX allows innovative and non-traditional industry partners to demonstrate their technologies and concepts in near-operational environments and get direct feedback from naval scientists, engineers, Sailors and Marines.

In FY 2020 we executed an ANTX hosted by Naval Air Warfare Center Aircraft Division (NAWCAD). The ANTX was executed over a three-month period to accommodate COVID-19 protocols. The event supported two follow-on OTAs and two CRADAs to continue work with industry and academia. Additionally, the DON recently completed the Naval Integration in Contested Environments ANTX. The event focused on Expeditionary Advanced Base Operations in support of DMO. The event was led by the NR&DE, primarily by Naval Information Warfare Center Atlantic, MCWL, and Naval Surface Warfare Center Crane. The event was conducted at Camp Lejeune from April 5-16, 2021, following strict COVID-19 protocols. The event explored 65 technologies and is currently compiling assessments

performed by engineers, technicians, Sailors and Marines. This ANTX provided an opportunity for the government participants (operational and technical) to experience the innovative technologies being developed by industry, and provided a forum for intellectual exchange between all participants.

Later this year, the Navy plans to conduct another ANTX hosted by NAWCAD. The theme of the event is Joint War At Sea / DMO. The event will be conducted in a Live, Virtual, and Constructive environment and will explore 35 technologies. The Navy is reaching out to Industry and Academia on three technology areas to determine the "art of the possible". The three areas of focus are Resilient Data and Network Communications, UAS Autonomous Technologies and Autonomous Tools and Alternative Position Navigation Timing (Alt-PNT). As part of the FY 2021 NAWCAD ANTX, the Warfare Center will be hosting an Aviation Cyber Rodeo slated for August 2021. The event will focus on aviation cyber test capabilities of NAWCAD, support aviation test events, and disseminate information about vulnerabilities and capabilities to participants.

NavalX and Tech Bridges

Scaling innovation toolsets is key to enhancing the impact of R&D. NavalX, the DON's agile cell, was established in 2019 to consolidate lessons learned from activities such as ANTXs and centrally facilitate rapid adoption of proven agility-enhancing methods across the DON. The small NavalX team guides, empowers, and connects our workforce to achieve pivot speed at an enterprise scale by building workforce capability and hosting workshops, prize challenges, industry events and pitch days to share methods to scale and develop skills. By coalescing talent in networks of collaboration and breaking down silos, NavalX helps accelerate the pace of discovery, learning and experimentation between collaborative partners and the DON.

Through its Tech Bridges initiative, NavalX is building a network comprised of innovation organizations, local industry, academia, small business, and other government entities to increase collaboration, knowledge sharing, and innovation. By connecting DON initiatives, increasing local access to innovation ecosystems, and reducing the barrier between the DON and non-traditional partners, this initiative will accelerate solutions to the warfighter. The Tech Bridge network is comprised of 15 locations both in the U.S. and abroad. Over the past year, this network generated more than 20,000 connections, $50 million in projects such as prizes

challenges and SBIR projects, and enabled more than 126 different projects in subjects like AI/ML; 5G-enabled technologies; advanced materials and manufacturing; maintenance and sustainment; autonomy; and data management.

Infrastructure

The NR&DE is host to a broad spectrum of state-of-the art facilities, laboratories, and ranges that represent the full spectrum of RDT&E capabilities across all warfighting domains. The WCs alone consist of more than 500 unique laboratories and facilities, and five major test ranges. A ready, relevant, mission-focused workforce equipped with unique hands-on expertise and know-how, coupled with government-owned, integrated, multi-level security laboratories, facilities and ranges, provides innovative solutions for rapid prototyping and fielding and technical execution for programs of record. The closed-loop Live Virtual Constructive environments resident within the NR&DE replicate and support multiple missions up to and including the high-end fight.

The DON continues to expand partnerships with industry and non-traditional entities through OTAs, CRADAs, SBIRs, and other agreements, which enables industry to include small business to leverage the unique infrastructure capabilities within the NR&DE to develop, demonstrate, and mature technologies in an operationally relevant environment.

Continued investment in the sustainment and modernization of these one-of-a-kind facilities is imperative to delivering the capability and capacity necessary to support both current and future readiness. Whereas the collective capability of this laboratory enterprise is unmatched anywhere within industry, some of the infrastructure dates back as many as 75 years. Aging infrastructure continues to drive increased requirements for sustainment, restoration, and repair. 10 USC 2363 (formerly known as "Section 219") enables the investment in infrastructure, combined with LRP authorities, continues to be a critical enabler to boosting sustainment, restoration, and modernization of critical laboratory infrastructure.

Improving Technology Security

Historically, the Navy and Marine Corps have enjoyed an overwhelming military capability advantage over adversaries. That advantage is based on the development and delivery of effective systems to the operational Navy. We collaborate with, and depend upon, our defense

industrial base to protect and deliver sensitive, classified programs. These mature, sensitive programs are rooted in fundamental research, facilitated by a dynamic, collaborative, fast-paced "open" research environment, exploring principles of basic and fundamental science. While this open approach is an advantage, it also creates a vulnerability. Therefore, we continue to work with OSD and across the Services to address these challenges in a more systematic way and in consideration of constantly evolving technologies.

Congressional Authorities

The DON wholeheartedly thanks members of Congress for the authorities granted to use for workforce, mission execution, and capability development and delivery. These authorities have been particularly beneficial to the DON, allowing us to develop innovative methods for effective management and mission execution at our warfare centers and laboratories. For example:

Title 10 USC 2363 (formerly Section 219 of Public Law No. 110-417)

This authority continues to pay dividends for the DON, providing the STRLs with another mechanism to enhance technology transitions, advance the technical workforce, expand technical knowledge, and improve infrastructure. In FY 2020, innovation in the following areas were achieved: Counter Small Unmanned Systems, Microelectronics, Machine Learning with Synthetic Imagery, and Digital Thread Additive Manufacturing.

Section 233 of Public Law 114-328

Section 233 granted DoD the ability to pilot changes in methods for more effective development of technology and management functions at eligible centers. The WCs and NRL nearly doubled the number of Section 233 initiatives by implementing a total of 34 management initiatives, which led to greater efficiencies and effectiveness, decreasing processing time by nearly 1.3 million days. The DON appreciates the efforts of the Committee to extend this valuable authority until 2027.

Workforce

The WCs and NRL frequently use Title 5 USC 9905, as amended by the FY 2020 National Defense Authorization Act (NDAA) Section 1109 -- Modification of direct hire authorities for the Department of Defense. NAVSEA alone has used this authority 330 times to date. In FY 2020, we were able to reduce the average time to hire to 65 days, which is approximately 20 days shorter than the overall Navy average over the same time.

The WCs and NRL consider the FY 2016 NDAA Section 1109 -- Pilot Program on Dynamic Shaping of the Workforce to Improve the Technical Skills and Expertise at Certain Department of Defense Laboratories -- to be a valuable authority. The DON STRLs have used VSIPs and VERAs several times in 2020, which has facilitated the shaping of the workforce to better align with future core competencies.

Conclusion

American security rests upon our ability to control the seas and project power ashore. In our digital age, it also requires power projection in space, cyberspace, and along the electromagnetic (EM) spectrum. Successful modern sea control demands all-domain power of our Naval and Joint Force, and we are determined to ensure our Forces are armed with technically superior capabilities.

Within the NR&DE, our continued investment in people, tools, and infrastructure to enable continuous learning, collaboration, agility, and cutting-edge capability to delivery at speed for our naval forces will ensure the preservation of national security and the maintenance of future naval power. I invite you to visit us and our Warfare Centers, NRL, ONR, laboratories, and the UARCs around the country to see firsthand the advances under development. I am honored to have the opportunity to testify before you, and I look forward to your questions.