

Maintaining Dominance in the Undersea Domain During SSN Gap Years

UNDERSEA WARFARE DIVISION



EXPANDING THE UNDERSEA ADVANTAGE

THE NAVY THE NATION NEEDS

At the Naval Undersea Warfare Center (NUWC), we have nearly 150 years of history to draw upon in support of doing what's right for the Navy: delivering full-spectrum technical advice and solutions to our partners across the entire lifecycle of platforms and systems that may remain in service for 40 to 50 years. We are understandably proud of the technical expertise and innovativeness that has made such longevity possible.

Ironically, our future success may well hinge on our willingness to embrace changes that aren't rooted in historical precedents, increasing our risk tolerance for disruptive technologies, and continuously challenging current policies in order to deliver performance at the speed of relevance. Only through such adaptation and collaboration with industry across the undersea community will we be able to outpace any threat that comes our way.

In the spring, we talked about six elements that Adm. John Richardson, the Chief of Naval Operations (CNO) set out to achieve and maintain the "Navy the nation needs" to meet the demands of the 2018 National Defense Strategy: a bigger, a better, networked, more talented, more agile, and more ready Navy. The CNO emphasized that these elements must be developed in balance to achieve "wholeness," and underscored urgency, effectiveness, and expediency as overarching themes for achieving success. If anything has changed in the intervening months, it's that the increasingly competitive

and rapid pace of change of technology is driving the direction we receive from our senior leadership to go faster in adopting technology and getting it in the hands of the fleet. This imperative is only likely to grow with time, as the number of available nuclear-powered attack submarines dips in coming years.

How do we respond? Much of our success or failure is going to be rooted in our ability to embrace the cultural shifts noted above, and to do so quickly. For instance, when recently asked whether technology is driving an evolution or revolution in underwater affairs, our response was an emphatic "yes" to both because the two paths can be complementary. The demand signals from leadership and the fleet requires us to meet near-term needs while simultaneously developing potential solutions for long-term challenges. The undersea enterprise is applying technologies for evolutionary advances – notably on the Virginia and Columbia platforms– and more revolutionary ones in areas such as autonomy enabled by artificial intelligence (AI) and machine learning. Future undersea warfare will comprise the right mix of evolutionary and revolutionary responses that leverage mature and developing technologies.



Donald F. McCormack
Executive Director, Naval Surface and Undersea Warfare Centers



Rear Admiral Moises DelToro, III
Deputy Commander for Undersea Warfare, Naval Sea Systems Command (SEA07); Commander, Naval Undersea Warfare Center (NUWC)

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EXPANDING THE UNDERSEA ADVANTAGE

Figure 1 illustrates the challenge that we face today. DOD 5000, as depicted by the blue line on this chart, set out a deliberate, low-risk approach to acquisition that doesn't meet the Navy's needs in an era of rapid technology advancements. It is purely evolutionary in nature.

The gray line, though more revolutionary, reflects where we in the military incorporate more from industry, but it is still not fast enough. Today, we need to find ways to make the red line a reality. We need to accelerate our adoption of capabilities with the tools that are available to all of us, collectively. For example, we are investing in Model Based System Engineering (MBSE), Virtualization,

If we're going to field capability in both the near- and far-term, we need to be asking (and solving) the hard questions now. In order to succeed, we will have to out-think, out-manuever, out-partner, and out-innovate revisionist powers, rogue regimes, terrorists, and other threat actors. This is where industry, through events like the NDIA Joint Undersea Warfare Conferences, plays an important role, because we gain the benefit of your perspectives, experiences, and concerns as we address difficult questions. For example, we must identify for development and fielding the right offensive capabilities and effects and we need to strike the right balance for sharing the research to benefit our international allies while protecting sensitive

information from potential adversaries. We must consider how we acquire and deploy systems –AI comes to mind– that will have ethical and policy ramifications for the Navy coalition or for our industry partners and how do we respond when faced with adversaries who may not operate

with fleet operators via live demonstrations to leverage their full mission effects. This can only be accomplished through ongoing collaboration where we share our focus areas and priorities, innovation where we take this new knowledge and apply it to research for fleet needs, and demonstration at events like Advanced Naval Technology Exercises. Since the first one several years ago in Newport, many other Warfare Center Divisions have conducted similar successful events. These low risk, collaborative demonstrations are a great way to bring technology capabilities that meet mission needs directly to the fleet and other industry members with the goal of mining very mature technologies for anyone of the many rapid acquisition pathways.

We are also looking to maximize other non-traditional tools and partnerships to help bridge the "valley of death" between technology development efforts and production programs to get innovative products into the hands of the warfighter more quickly. These include extending sharing information about our investments, industry days, and utilizing Other Transaction Authority to help speed development of promising programs and having discussions about what can be done versus what the government stipulates the requirements to be. We look forward to once again participating in the NDIA Fall Joint Undersea Warfare Conference. It offers a superb forum for discussing the many challenges the undersea warfare community is facing and gives us an unparalleled opportunity to collaborate in support of our Warfighters.

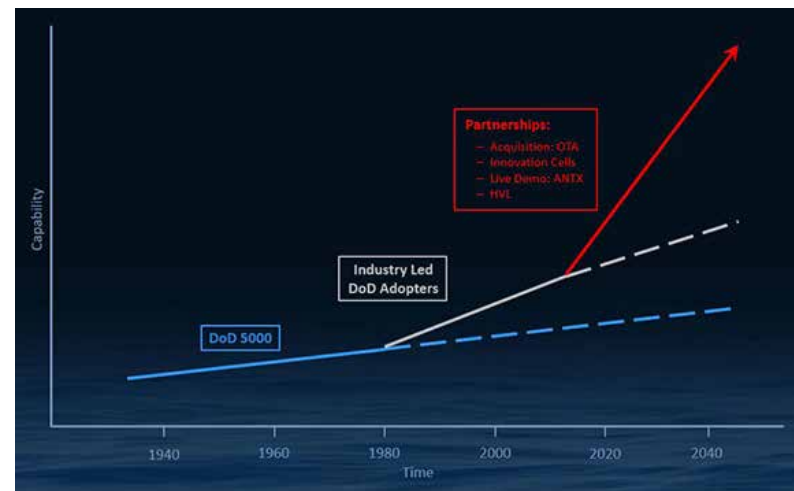


Figure 1 – Getting Faster

Live Virtual Constructive (LVC) simulation to accelerate technology development, Test and Evaluation, and Training.

The need for speed and a dual path to transition capabilities to the fleet are reflected in higher-level guidance. The National Defense Strategy notes that "new commercial technology will change society and, ultimately, the character of war" and because "many technological developments will come from the commercial sector" the most advanced technology is available to both state and non-state actors, which "risks eroding the conventional overmatch to which our nation has grown accustomed." It goes on to say that our forces must be prepared to confront technological surprises on the battlefield, such as "big data" analytics, hypersonics, autonomous systems, robotics, biotechnology, and AI. The National Defense Strategy further stipulates the building of a lethal force as one of three distinct lines of effort, with AI being a focal point of that effort.

with similar values?

Within the Warfare Centers, we are investing in technologies that are fundamental to this effort through our NISE/219 and internal funding. We must make the most of these investments, so once we identify a technology that's promising, we can collaborate with industry to take it to the next level. Figure 2 shows how innovation is shared with Government, academia and industry to quickly transition through collaboration and partnership. AI and machine learning are prime examples, but we are also investing in areas such as meta-materials, quantum physics, bio-mimetics, directed energy, and digital science. As our systems and platforms become more distributed, unmanned and networked, command and control, cybersecurity, anti-tamper, and trusted electronics are risks we must address. We must mature these technologies in collaboration

DIVISION CHAIR'S MESSAGE



MIKE TUCKER
CHAIR UNDERSEA WARFARE DIVISION

On behalf of the entire management team of the National Defense Industrial Association

Undersea Warfare Division, welcome to the Fall Conference. Our goal is to provide you the best classified forum for understanding the Navy's vision, objectives and plan for maintaining undersea warfare superiority; and the best opportunity to interact with our diverse undersea warfare community. Please provide feedback on how we are doing and how we can improve.

A special thanks to all of our plenary and technical committee speakers for taking the time to brief our USW community. Your briefs and the resulting discussions

are the reason we are here as we put the information you provide to good use for the warfighter.

There is no doubt that these are challenging times. We are met with the challenge of increasing adversary OPTEMPO and geographic reach even as the impact of submarine force structure decisions of previous years arrives. While demand signals for our submarines continues to increase, our submarine force structure will realize reductions. Our challenge is to respond and maintain Maritime Superiority in the face of this reality. This challenge is captured in our theme for this conference "*Maintaining Dominance in the Undersea Domain during SSN gap years*".

Thank you NUWC for hosting this event. Accommodating the increase in OPTEMPO required to plan and support

this long running conference is more than appreciated. The history and experience are irreplaceable.

On behalf of the Executive Board, the Advisory Council and NDIA, thank you and your organizations for continued support of the National Defense Industrial Association, the Undersea Warfare Division and these conferences. We hope you enjoy the Fall Conference, the clam bake and look forward to seeing you at the Spring Conference in San Diego. Planning for the Spring Conference has already begun!

Warfighters First!

Mike



Figure 2- Communicate / Collaborate / Innovate / Demonstrate

SPRING 2018 NDIA UNDERSEA WARFARE AWARDS



PIERRE CORRIVEAU, PHD
Chairman Awards Committee

At this year's spring conference, the Undersea Warfare Division (UWD) of the National Defense Industrial Association (NDIA) was pleased to announce the recipient of the **Vice Admiral Charles B. Martell-David Bushnell Award** to Mr. Peter Scala, Principal Assistant

Program Manager for Advanced Development (PEO-IWS5A); the recipients of the **Vice Admiral Charles E. Weakley Award** to Mr. Jack Evans, former Executive Director of PEO Submarines and to Capt. Brian T. Howes, SES USN (ret), Deputy Director, Undersea



MR. PETER SCALA
Director for Advanced Development within the Undersea Systems Program Office (PEO IWS5.0)

The **VADM Charles B. Martell-David Bushnell Award** for exceptional contributions in the field of ASW and/or Undersea Warfare Technology.

Over his long career, through his steady leadership and unwavering dedication, Mr.

Scala has significantly impacted our USW Community. A retired post command submarine officer of 27 years, Mr. Peter (Pete) Scala is Director for Advanced Development within the Undersea Systems Program Office (PEO IWS 5.0), responsible for leading the rapid transition of advanced technology to USW programs.

Mr. Scala has expertly directed the development of USW systems including Advanced Processing Builds (APB) and Advanced Capability Builds (ACB) for submarine and surface systems respectively, as well as submarine towed array systems. He led



MR. JACK EVANS
Former Executive Director, PEO Submarines

The **VADM Charles E. Weakley Award** for meritorious service and noteworthy contributions to effective Government Industry communications in the field of Undersea Warfare.

For over four decades, Mr. Evans has led the design, development, acquisition, construction, and testing of activities for critical undersea systems. Mr. Evans served in several key senior government leadership positions, including Director of the OHIO Replacement Program, Executive Director of PEO Submarines, and Deputy Director for Naval Warfare Systems for the Office of Secretary of Defense (ASD) Acquisition, Technology, and Logistics. He has challenged and motivated the undersea warfare community to build and sustain the world's greatest submarine force. Currently, Mr. Evans works at the John Hopkins University Applied Physics Laboratory, representing PEO SUBS under the Intergovernmental Personnel Act. He leads a government and

Warfare Division Chief of Naval Operations (OPNAV N97B); and the **Captain George W. Ringenberg Award** to RADM Phil Davis USN (ret), the former Program Executive Officer Submarines. In addition, we had the pleasure to announce the recipient of the **Rear Admiral Jack Jarabak Award** to Lt Joshua Collins for his exceptional contributions in the field of Anti-Submarine Warfare.

Unfortunately, Mr. Howes, RADM Davis and Lt Collins were unable to attend the Spring Conference and will receive their award at a later date

the development for the Conformal Acoustic Velocity Sonar Large Vertical Array (CAVES LVA) which is proving to be a game changing technology in the Undersea Domain.

Mr. Scala has been recognized throughout his career for his innovative and forward thinking concepts. Recently, he led the Tactical Advancements for the Next Generation (TANG) team in addressing some of the Navy's toughest human-centered challenges by bringing together a diverse group of stakeholders – military and civilian – to create powerful solutions. He has championed a rapid prototyping approach which has resulted in the delivery of 7 new capabilities and the creation of over 50 concepts which are in various stages of prototyping and development.

For his excellent leadership and unwavering dedication that has significantly benefited our Submarine Force, the Undersea Warfare Division of the National Defense Industrial Association was honored to present this prestigious award to Mr. Peter Scala.

industry team in the development of an integrated plan to most affordably acquire and build the submarine force of the future, including future Virginia Class blocks, the Columbia-class, and the follow-on SSN.

Mr. Evans' keen intellect, leadership, and critical analyses have impacted the submarine force in numerous ways. He is a recognized leader in submarine systems engineering and acquisition. He has made significant contributions to the modernization or construction of every class submarine since Los Angeles and Ohio.

In recognition of his noteworthy contributions to advancing the field of Undersea Warfare and in promoting effective government/industry communications, the Undersea Warfare Division of the National Defense Industrial Association was pleased to present Mr. Jack Evans with the VADM Charles E. Weakley Award.



CAPT. BRIAN HOWES, SES USN (RET)
Deputy Director, Undersea Warfare Division Chief of Naval Operations (OPNAV N97B)

The **VADM Charles E. Weakley Award** for meritorious service and noteworthy contributions to effective Government Industry communications in the field of Undersea Warfare.

In his over 30 years of service, Mr. Howes has distinguished himself as a commissioned officer in the United States Navy and currently as a Senior Executive in the Office of the Chief of Naval Operations. As the Deputy Director, Undersea Warfare Division, Mr. Howes is the principal civilian advisor to the CNO and Commander Submarine Forces on all matters relating to current and future undersea programs. He routinely engages with Navy leadership to better promote and sustain an atmosphere of trust, goodwill and understanding in order to ensure growth

in undersea warfare capabilities and capacity. As the principal conduit to industry for submarine platforms and payloads portfolio management, Mr. Howes regularly meets with industry, both large and small, to advance undersea systems opportunities including unmanned undersea vehicles. Mr. Howes also ensures that senior Navy Leadership maintains active participation during all technical sessions at the Undersea Warfare Conferences, Symposiums and formal engagements with industry.

In recognition of his noteworthy contributions to advancing the field of Undersea Warfare and in promoting effective government/industry communications, the Undersea Warfare Division of the National Defense Industrial Association was pleased to present Mr. Brian Howes with the VADM Charles E. Weakley Award.



RADM PHIL DAVIS USN (RET)
Former Program Executive Office, Submarines

The **Captain George Ringenberg Award** is presented to those who, through their service and leadership, have made noteworthy contributions to the Undersea Warfare Division.

RADM Davis' leadership and dedication to Undersea Warfare has spanned both his naval and civilian service. He has held increasingly responsible roles in the U.S. Navy that culminated as the Program Executive Officer Submarines where he advanced the nation's undersea warfare (USW) enterprise to sustain this nation's Undersea Dominance. Since his active duty retirement, in 2006, he has supported the NDIA Undersea Warfare Division (UWD) and has been a strong advocate for USW. As a UWD Advisory Council member, he continued his advocacy of USW as an active advisor to senior Naval Flag Officers. He has promoted the need for the development of a broader USW strategy that encompasses a wide range of different capabilities, systems, and platforms, including; intelligence, oceanography, surveillance systems, submarines, and weapons.

As a UWD Advisory Council member, Phil Davis has contributed significantly to the smooth and efficient execution of the Division's programs. Employing his vast knowledge of USW, coupled with his expertise as an acquisition professional, he was instrumental in the shaping of the UWD vision. He selflessly devoted his time to provide sage advice and council to conference chairs and Division chairmen. When faced with the Budget Control Act and limitations on conference attendance by government officials, Phil provided sound options to Division leadership to help guide the Division's future. Phil helped review key UWD documents that enabled the Division to submit thoughtful recommendations to the Secretary of the Navy on the status of undersea warfare. His actions throughout his career have helped our Nation achieve and maintain undersea dominance. A consummate professional, John Phil Davis has upheld the highest traditions of the Undersea Warfare Division.

The Undersea Warfare Division was proud to recognize RADM Phil Davis, USN (ret) with the Captain George Ringenberg Award for his outstanding contributions and service to the U.S. Government, the National Defense Industrial Association, and the Undersea Warfare Division.



LT JOSHUA COLLINS, USN
Academic achievements in USW Undersea Warfare Technology at Naval Postgraduate School

The **Rear Admiral Jack Jarabak Award** is presented each year by the UWD in conjunction with the Naval Postgraduate School's Undersea Warfare Executive Committee, to recognize a deserving student for his or her contribution in the field of USW.

This year the award was presented to LT Joshua Collins, USN, for his personal commitment and academic achievements in the area of Undersea Warfare Technology.

While attending the Naval Postgraduate School from September 2015 to September 2017, LT Collins distinguished himself through outstanding performance in the Undersea Warfare Curriculum. His exceptional research clearly demonstrates his intellectual ability, analytical skills, and mastery of material science. His thesis,

"Bio-inspired micro-electro-mechanical-system (MEMS) technology Underwater Direction Finding Acoustics Sensor," increases our understanding of using a proven Ormia ochracea fly-sized sensor in an underwater environment. This micro-sensor could provide a remarkable sensitivity to the direction of sound having two orders of magnitude longer wavelengths than our traditional acoustic sensors, and has the potential to revolutionize unmanned undersea vehicle capabilities. His superior performance in this program strongly indicates his great potential for success in improving our undersea warfare posture.

The Undersea Warfare Division, in conjunction with the Naval Postgraduate School, took great pleasure and welcomed the opportunity to recognize the important contributions of LT Joshua Collins, USN, by its award of the 2018 RADM Jack Jarabak Bronze Medal Award.

NDIA UWD 2018 ACADEMIC SPEAKER AWARD



MARK ROTHGEB
Chairman, Academic Fellowship Committee

The NDIA Undersea Warfare Division (UWD) established the Academic Fellowship Program in 1990 to provide financial aid to Ph.D. candidates at universities closely associated with the Navy's undersea warfare community. The objective is to encourage outstanding science and engineering students specializing in fields pertinent to undersea warfare to present their research at our conferences. The student candidate pool is primarily derived from the Navy's University Affiliated Research Centers (UARC)s and the Naval Postgraduate School (NPS). This spring we are pleased to host seven academic research contributors from a variety of organizations covering a broad spectrum of topics.



Thomas Blanford is a Graduate Research Assistant at the Applied Research Laboratory and a Ph.D. candidate in the Graduate Program in Acoustics at The Pennsylvania State University in State College, PA. His research investigates the design and modeling of correlation velocity logs (CVLs) that are suited for the navigation of

small unmanned underwater vehicles (UUVs). Correlation velocity logs can provide a bottom referenced velocity estimate using substantially lower power than other types of acoustic navigation aids. His talk will discuss new models, operating paradigms, and the important design considerations for CVLs to enable them to aid the navigation of small UUVs.



Justin McCorkle graduated summa cum laude from George Fox University with a degree in Electrical Engineering. He commissioned into the US Navy through Officer Candidate School in 2011. After finishing Nuclear Power School and Prototype, he reported to the submarine PCU North Dakota and qualified as Engineer. He has spent the last two years at the Naval Postgraduate School studying Undersea Warfare while pursuing a MS in Electrical Engineering. He will be presenting in the Mine Warfare session on the topic "Active Sonar Matched Waveform for Resonant Spherical Mine Target" and will discuss the application of match waveform illumination as used in RADAR to underwater SONAR waveforms.



Christian Martin is a Graduate Research Assistant at Virginia Tech as well as Master's candidate in the Aero/Hydrodynamics Program at the Aerospace and Ocean Engineering Department. After obtaining his Master's, he plans to continue his research while obtaining a Ph.D. His research consists of

density and more specifically thermally buoyant jets in stratified background environments and their evolution through time and space. He will be presenting in the Undersea Sensors session on "Hybrid Reynolds-averaged Navier Stokes/large-eddy simulation (HRLES) of buoyant jets in stratified liquids" including discussions of undersea applications and directions for future research.



John McKay earned a master's degree in applied mathematics at Arizona State University and a Bachelor's degree in mathematics at Pitt. He recently completed his electrical engineering doctoral program where he studied synthetic aperture image formation and analysis. He is currently working at Penn State's Applied Research Laboratory with a focus on machine learning applications. Among his interests are sonar/radar specific neural network architectures, phase inclusive algorithms, and frequency domain methods for synthetic aperture imaging.



Matthew Jones is a Graduate Research Assistant and Ph.D. candidate in the Department of Aerospace and Ocean Engineering at Virginia Tech. He earned a Bachelor's degree in Aerospace Engineering from the same department and was awarded the Roll's Royce Commonwealth Fellowship to continue his studies as a graduate researcher. In his research he investigates the near-field and far-field wake dynamics of marine vehicles. His presentation will discuss how variations in design parameters of an underwater vehicle change the near-field wake profile and how these changes in the wake are important to the operation of the vehicle.



Brendan McNelly holds a bachelor's and master's degrees in Mechanical Engineering from the University of Maryland ('14) and Penn State University ('15). He is currently pursuing a master's degree in Electrical Engineering from Johns Hopkins University with a focus in robotics and mechatronics. Brendan is currently employed at the Johns Hopkins University Applied Physics lab as a mechanical engineer, where he designs and rapidly prototypes systems that improve capabilities of the military. The majority of his work is introducing innovation to the naval fleet for defense of strategic platforms. His talk will discuss the design and development of a new autonomous underwater vehicle capability.



Andre Douglas is our final student presenter and will be presenting on the design and analysis of swarming architecture for unmanned systems in air, sea, and space environments using goal-oriented requirements engineering. Andre works in the Oceans Systems Engineering group at the Johns Hopkins University Applied Physics lab and is pursuing his PhD in Systems Engineering at the George Washington University.

Andre Douglas is an Assistant Section Supervisor of the Mechanical Section in the Ocean Systems Engineering Group at the Johns Hopkins University Applied Physics Lab (JHUAPL). He earned a bachelor's degree in mechanical engineering from the U.S. Coast Guard Academy and dual master's degrees in mechanical engineering and naval architecture/marine engineering from the University of Michigan. Andre is currently enrolled at George Washington University as a Systems Engineering PhD candidate while concurrently enrolled in the JHUAPL engineering professionals program pursuing a master's degree in electrical engineering. He routinely works on technical projects involving system development, test and evaluation, modeling and simulation, analysis of alternatives, and concept design for various applications.

UNDERSEA COMMAND, CONTROL, COMMUNICATIONS AND COMBAT SYSTEMS COMMITTEE



PAUL ROSBOLT
Chairman

DR. BOB ZARNICH
Deputy Chair

JOHN LINDERMAN
Warfighter Performance Session Chair

Greetings, All! I'm looking forward to a great conference in Connecticut! Any excuse to get out of Washington is a good one. We have some terrific speakers lined up for the technical sessions, including CAPT Doug Adams, Program Manager for Undersea Systems (IWS5), CAPT Mike Boone, Program Manager for Undersea Communications & Integration (PMW 770), and CAPT Gregory Zettler, from PMS 425, Submarine Combat Systems. ONI will also have some special presentations!

The Navy is in the midst of addressing issues with theater undersea warfare (TUSW) command and control (C2) through a concerted effort to transition technology rapidly to the warfighter. Current TUSW C2 systems, managed by disparate resource sponsors, were not necessarily designed to interface with each other or higher echelon commands and TUSW assets, some are no longer supported, and many have an over-reliance on manual processes. This has resulted in the warfighters dealing with issues related to life cycle support, training, system interoperability, information sharing with allies and coalition partners, and data transfer across security domains.

Led by PEO IWS 5.0, OPNAV N2N6F, UWDC and the Theater ASW Warfare Commanders, the Navy organized a Theater ASW (TASW) Integrated Product Team (IPT) three years ago to begin formally addressing these issues. Through the TASW IPT, the Navy defined a common vision for TUSW C2, applied innovative design thinking through a TASW Tactical Advancements for the Next Generation (TANG) workshop, and formally documented Fleet TASW requirements.

In response to these efforts, the Navy has allocated funding starting in FY19 for Project NAUTICA (Networked Architecture for Undersea Theater Integrated C2 Advantage), a cross-PEO and OPNAV effort to implement a common C2 system-of-systems architecture at each TUSW Operations Center (TUSWOC).

In concert with the recently created OPNAV Digital Warfare Office (DWO), Project NAUTICA will work through a comprehensive TUSW requirements allocation process to clarify both the framework for federating the various programs of record that exist at the TUSWOCs, and the allocation of requirements to programs when there is uncertainty. The results will inform existing system acquisition efforts, allow the application of the proven AxB development process where it is needed, and identify where innovation is required to close capability gaps. In particular, providing a place to develop and test future capabilities via a "sand box" construct as part of each system's DEV/OPS process is instrumental.

These efforts seek to ensure that our TUSW C2 capabilities are adequately resourced and supported across the entire life cycle of the various systems. C2 system requirements will be clearly allocated to resource sponsors and program offices, with processes in place to address seam issues and future requirements. Through aggressive incremental improvements, TUSW C2 will realize significant benefits from automation that makes sense, and improved cyber resiliency, multi-layer security and information sharing across all assets and domains. Ultimately, Project NAUTICA will maximize decision superiority, enabling more effective and timely theater-level C2 to employ more effectively our TUSW systems and platforms.

UNDERSEA MINE WARFARE COMMITTEE



JON TOBIAS
Chairman

ERIC HOLMES
Deputy Chairman

This Fall, the Mine Warfare (MIW) Committee is fortunate to have an excellent line-up of government and industry technical session speakers, including Dr. Peter Adair, who'll provide an update on Naval Surface Warfare Center Panama City Division's investments in the warfare area. In addition, CAPT Ron Toland, Deputy Director for MIW at the Naval Surface and Mine Warfighting Development Center (SMWDC) will be providing a brief on 'Mine Countermeasures – A Fleet Perspective.'

There continues to be a significant amount of activity across MIW programs, as multiple new systems near readiness for transition to the fleet, and others begin development. Recent activity includes:

- In March, the Navy announced that Program Executive Office (PEO) Littoral Combat Ship (LCS), was being renamed PEO Unmanned and Small Combatants (USC) to better align the course and scope of responsibilities for both manned and unmanned systems to meet combatant commander needs.
- The Unmanned Influence Sweep System (UISS) continues contractor testing, completing over 700 hours of in-water testing. The system has wrapped up builder's trials, is currently conducting pre-delivery inspection and trials, and will soon commence developmental testing. Milestone C is scheduled for 4th quarter, FY18.
- The Mine Countermeasures (MCM) Unmanned Surface Vessel (USV) minehunting program continues development, with a 2-unit USV craft contract awarded, and systems in the final stages of construction. Payload integration will follow but has been slowed based on FY18 budget reductions. Integration and testing will now occur in FY19.
- An AN/AQS-24B upgrade has been integrated with minehunting USVs (MHU). These systems continue to support Commander, Fifth Fleet in-theatre training and operations.
- AN/AQS-20C minehunting sonar production units continue contractor testing. Delivery of 10 units will support developmental testing, which is planned to begin in 4th quarter, FY18.
- In April the Coastal Battlefield Reconnaissance and Analysis (COBRA) system successfully completed its second phase of operational testing aboard San Diego-based USS Coronado (LCS 4).
- In April, Raytheon was awarded an \$83m cost-plus-incentive-fee contract to develop the Barracuda mine neutralization system, an expendable unmanned underwater vehicle (UUV) designed to neutralize bottom and moored mines.



The Coastal Battlefield Reconnaissance and Analysis (COBRA) System, mounted on the nose of an MQ-8B Fire Scout vertical takeoff and landing unmanned aerial vehicle

Mine Warfare featured prominently in two major exercises this summer. In June, the SMWDC mine warfare battle staff commanded a 16-nation MCM task group during the annual Baltic Operation (BALTOPS) exercise 2018. The SMWDC staff operated from USS Mount Whitney (LCC-20) and directed a group that comprised nearly half of the participating BALTOPS ships, including standing NATO MCM Group 1, and the Baltic MCM squadron. Supporting operations from the Spearhead-class expeditionary fast transport vessel, USNS Carson City (T-EPF 7), were Rota, Spain-based Task Force 68, and San Diego-based Mine Countermeasures Division Three One (MCMDIV-31). During July in San Diego, the SMWDC battle staff and MCMDIV-31 led a 1,100-person, seven nation coalition of MCM forces during the Rim of the Pacific (RIMPAC) exercise 2018. Participants included UUV teams from New Zealand and the Netherlands, explosive ordnance disposal (EOD) dive teams from Japan and New Zealand, USS Ardent (MCM-12), HMCS Whitehorse, MH-53E helicopters from Helicopter Mine Countermeasures Squadron Fourteen (HM-14), and MH-60S helicopters from Helicopter Sea Combat Squadron Twenty-One (HSC-21). The latter units utilized the Airborne Laser Mine Detection System (ALMDS), and Airborne Mine Neutralization System (AMNS) in their first non-test-centric exercise. PEO USC's Mine Warfare Program Office (PMS 495) is analyzing findings and key data.



Naval Aircrewman (Helicopter) 1st Class Alejandro Vega, assigned to the "Blackjacks" of Helicopter Sea Combat Squadron (HSC) 21, operates an Advanced Laser Mine Detection System (ALMDS) console aboard an MH-60S Sea Hawk helicopter during Rim of the Pacific (RIMPAC) exercise

Finally, no MCM committee article would be complete without mentioning the evolving leadership changes in the MIW community. In July, outgoing Director of Mine Warfare Requirements (OPNAV N952), CAPT Hans Lynch, along with Dr. Sam Taylor, an MIW senior leader at PEO USC, penned an article published by the Center for International Maritime Security that reveals the Navy's continuing journey away from tying the MCM mission area to specific ship types and a "one-size-fits-all" concept of operational MCM employment. The authors discuss the department's continuing focus in distributed MCM operations and the development of a modular MCM force that transcends reliance on the Littoral Combat Ship.

As always, I challenge you to stay engaged and creative as we collectively improve delivery of warfighting capabilities to the U.S. Navy.

UNDERSEA WARFARE VEHICLES COMMITTEE



TOM RUZIC
Chairman

CHUCK FRALICK
Deputy Chair

WHITHER THE VERTICAL UUV?

BY TOM RUZIC

Which comes first: the bullet or the gun?

It's THE fundamental question for those of us in the defense industry.

The correct answer is, of course, "Both." All weapons are initially conceived of as a system, and when the mission requirements are known (kill the quail), the bullet is sized (a rock about an inch in diameter) and the gun (a slingshot capable of launching said rock ~30 yards) follows suit.

In the world of undersea warfare, the guns have been around for a long time and they are almost entirely 21 inches in diameter. The gun has remained fairly stable, but the bullet it shoots has evolved over time. The life cycle of submarines is very long and the bullet will invariably change while still requiring to be shot from the same old gun.

As one who works on the design of 8000+ ton submersible platforms, I'm firmly in the "gun" camp. I would be remiss to ignore the developments in the "bullet" arena, because after all, the two must work together.

And while the 21" diameter gun isn't going away, the Trident SSGN program has brought another gun to the platform: the 80 + inch diameter one. For VIRGINIA Class submarines starting with the SSN784 and later, there are two of these large tubes in the bow.



The commissioning of the USS John Warner (SSN 785) - Manning the rails

Starting with SSN802 and later, there will be an additional four aft of the sail in the Virginia Payload Module. So the future of undersea payloads will reside in an increasing number of large vertical tubes.

In terms of bullets, there is no shortage of munitions that have been developed to launch from these guns.

But I'd like to talk about a different kind of "bullet:" the UUV.

All indications show mankind on an irreversible trajectory of automation. Since the inception of the humble Roomba vacuum cleaner, we seem to be headed to a future of All Things Unmanned. While air, ground and surface vehicles are rapidly advancing, unmanned underwater vehicles are maturing also, although not as fast. You can learn about many of these vehicles via this particular division of NDIA.

Looking at the future of undersea warfare, and wanting to “skate to where the puck is going to be” (a la Gretzky) I foresee the intersection of two trends:

Lots of vertically oriented payload volume (guns)

Lots of unmanned undersea vehicles (bullets)

If indeed UUVs are going to be carried into theatre via VIRGINIA Class submarines, these two trends beg a practical question:

Is there a UUV on the market today compatible with being stored vertically (possibly for a long period of time), launched, reoriented to the horizontal attitude and then able to perform its mission?

Perhaps that UUV exists and I'm not aware of it. Perhaps the reorientation is a trivial engineering problem to solve. Perhaps the 774 Class won't carry UUVs in the large payload volumes.

But if our manned undersea platforms are to carry UUVs that must be launched horizontally, then they will take up what has been heretofore considered valuable payload volume filled by war shots. Is that an acceptable trade?

These big guns will be around for a long time. Will we have all the right bullets?

I welcome your response via an abstract at a future Undersea Warfare Division conference.

UNDERSEA WARFARE AVIATION COMMITTEE



GLEN SHARPE
Chairman

MR. BOB KANYUCK
Deputy Chairman

CAPT. DOUGLAS BELVIN, USN
(NAVAIR PMA-264), Navy Liaison

Welcome back to Groton and hope everyone has had a great summer. I'm sure looking forward to a great session that builds up existing relationships and forges new ones with subject matter experts from across the undersea warfare domain. Aviation undersea warfare is much more than fixed and rotary wing platforms that drop sonobuoys or deploy dipping sonar although that is an important element. It's the community evolution and expanded vision to include unmanned aerial vehicles (UAV) that will address a wide variety of undersea warfare and maritime surveillance scenarios in a rapidly changing world that is most impressive. Advances in acoustic and non-acoustic sensors, weapons, signal processing, and training are making tremendous strides to keep up with the warfighting advancements of our adversaries. More specific accomplishments since we last met are provided below and released in the public domain.



Pete Garvin, Rear Admiral, U.S. Navy, Commander, Patrol and Reconnaissance Group, Commander, Patrol and Reconnaissance Group Pacific

CHECKING ON STATION MARITIME PATROL AND RECONNAISSANCE WARRIORS PAST AND PRESENT,

It is my distinct honor to “check on-station” as the 38th Commander of Patrol and Reconnaissance Group / Patrol and Reconnaissance Group Pacific. I'd like to thank RADM Trey Wheeler for his outstanding leadership of the Maritime Patrol and Reconnaissance Force (MPRF) over the past thirteen months. Admiral Wheeler not only expertly led the community through a challenging transition,

he is a devout operator and tactician that will bring his warfighter ethos to his next job as U.S. Cyber Command's Director for Plans and Policy (J-5).

To say it is great to be back in the community would be a bit of an understatement. Much has changed since I departed Wing 10 five years ago and virtually all for the better.

Since taking command, I have received many status updates regarding all facets of our community. It is inspiring to see how far the MPRF has come. When I departed Whidbey Island we were an all P-3/EP-3 force recovering from crippling “Red Stripe” that had grounded over half the Fleet. Today we have delivered 73 P-8A Poseidons to our operators and transitioned 9 of 12 active duty VP squadrons. The last squadrons to fly the P-3 will be our reserve warriors, VP-62 and VP-69, which the Navy intends to recapitalize with P-8A when aircraft inventory can support. Equally exciting, and important to sustaining the P-8A production line, is that some of our closest allies are either currently flying or planning to purchase the P-8A. The commonality of aircraft among MPRA international partners has a rich history and significantly increases our combat effectiveness both in terms of capability and capacity. By definition, a force multiplier.

However, our transformation to a new MPRF Family of Systems - comprised of P-8A, MQ-4C Triton, and TacMobile - is far from complete. The next few years will be exceptionally challenging as we field new capabilities, while continuing to operate our very effective legacy P-3 and EP-3 aircraft. The MPRF team is to be commended on safely and flawlessly executing a complex transition unprecedented in naval aviation. Simultaneously introducing two new Type Model Series aircraft and the ground systems to support them, with no mission degradation for our Fleet commanders, is no small task.

The Fleet has received its first two MQ-4C Triton Unmanned Aerial Vehicles (UAV). Flying from NAS Ventura County, CA, and controlled from NAS Jacksonville, FL, the jets are undergoing Operational Test with VX-1 and VUP-19. The Navy's first UAV squadron, VUP-19, is scheduled to begin operations this calendar year. Whether flying P-3, EP-3, P-8, or Triton, the performance of our crews on station remains our stock in trade and the reason the nation continues to invest heavily in our collective future.

The MPRF flies the U.S. Navy's only long range, airborne Anti-Submarine Warfare (ASW); Anti-Surface Warfare (ASuW); and maritime Intelligence, Surveillance, and Reconnaissance (ISR) platform. We have an awesome multimission aircraft, but make no mistake, ASW is our primary mission and our nation relies on us being the very best in the business of sinking enemy submarines. To that end we will employ every tool at our disposal to find, fix and, if ordered, finish any subsurface adversary. The reality of today's great power competition demands that we use every capability on board the P-8A Poseidon and MQ-4C Triton to conduct full-spectrum ASW against very capable adversaries. We must be ready to fight tonight and operate forward, independently, and with limited support. The hallmark of Maritime Patrol Aviation is that we are relevant to all phases of the fight; we get there first, prepare the battle space, conduct combat operations, and remain behind to secure the peace.

These are simultaneously challenging and exciting times for the MPRF. The aircrew, maintainers, intel and ground support personnel – both uniformed and civilian – represent the best our country and Navy have to offer. I also recognize and appreciate the sacrifices of all our families that allow us to go do the nation's bidding. I could not be more proud to be part of this winning team and the legacy of Maritime Patrol Aviation. I am looking forward to traveling back to Whidbey Island this fall and attending the Maritime Patrol Aviation (MPA) West Coast Reunion, 24-25 October. Until then Fly, Fight, Lead and Win!

With Great Respect,

Pete Garvin Rear Admiral, U.S. Navy Commander, Patrol and Reconnaissance Group Commander, Patrol and Reconnaissance Group Pacific



Unmanned Patrol Squadron (VUP) 19 successfully conducted their first flights as a squadron of the newest unmanned aerial system - the Northrop Grumman MQ-4C Triton. Photos courtesy of VUP-19.

VUP-19 CONDUCTS FRST MQ-4C TRITON FLIGHTS

The “Big Red” squadron, flew both of their MQ-4Cs, which had previously been delivered earlier this year for the first time out of Naval Base Ventura County, Point Mugu in California. Each aircraft was airborne for several hours to conduct functional check flights, testing the operability of the aircrafts' mechanics and systems.

These flights served as both the culmination of the years of hard work to establish VUP-19 as flight-ready, and the beginning of the squadron's next chapter as they prepare the aircraft for operational deployment.

The Tritons took off from California operated by pilots from both VUP-19 and the Navy's Air Test and Evaluation Squadron (VX) 1. Pilots worked from a forward operating base (FOB) as part of the squadron's detachment positioned there to facilitate the launch, recovery, and maintenance of the MQ-4C.

Following takeoff, control of the unmanned aircraft was passed to the main operating base (MOB) at Naval Air Station (NAS) Jacksonville, where VUP-19 and VX-1 pilots, flight officers and sensor operators conducted the operational portion of the event. Upon the conclusion of the flight, prior to landing, control of the Triton was returned to the FOB pilots in California who then brought the aircraft back in for a safe arrival.

“This is certainly an important milestone.” remarked VUP19 Commanding Officer Cmdr. John LeVoy, “I'm extremely proud of what the combined Big Red and VX-1 teams have been able to accomplish, and am looking forward to how the squadron handles the upcoming challenges with the Triton platform.”

Moving forward, VUP-19 plans to continue operating Tritons out of Point Mugu as they gear up for the aircraft's eventual move to Andersen Air Force Base in Guam. It is from this permanent forward-deployed position that Triton will enter its early operational capability to fly missions in the Pacific region.

VUP-19 is the United States Navy's first unmanned maritime patrol squadron, which was established in October 2013 and commissioned in October 2016.

Homeported at NAS Jacksonville with a permanent detachment to Naval Base Ventura County, Point Mugu in California, VUP-19's current mission is to operate the MQ-4C Triton in the baseline configuration supporting U.S Seventh Fleet operations.

UNDERSEA WARFARE SENSORS COMMITTEE



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MR. PETER SCALA
PEO IWS 5 NAVY LIAISON

“This year’s theme “Maintaining Dominance in the Undersea Domain During SSN Gap Years”

The Undersea Sensors Committee fall session received a good number of paper submissions ranging in topics from the traditional undersea sensors and processing for large manned platforms to sensors and processing for fixed surveillance systems and unmanned platforms. The papers are all well suited and in line with this year’s conference theme. A feature which seems to be becoming more and more prevalent in the submitted paper topics are undersea sensors and processing for unmanned platforms. Unmanned platforms are becoming a significant component in maintaining tactical and strategic superiority in the ever-changing maritime undersea environment.

In general, Undersea Sensors and processing can be divided into those associated with stationary or quasi stationary systems and those associated with mobile platforms. In the case of mobile platforms, these can be manned or unmanned. In the past, most of the focus of sensor development and signal processing for the case of mobile platforms has focused on large manned platforms where the available sensor space is large, power is not a great concern and with the human in the loop one could consider most forms of complex signal processing as a human is available to see the results of the processing and interpret the complex output. The processing provided detection, bearing estimates, derived range, localization and classification. All elements which are important when one considers the functions and what is at risk in a manned platform. Vast experience and knowledge have been accumulated in the design of the underwater sensor, the processing and the interpretation of the data.

Unmanned autonomous platforms represent an area where one expects significant platform developments in the very near future. A couple of current examples are PMS 406 XLUUV program and the Undertaker program. The missions to be performed by these platforms require critical undersea sensing and processing to provide data that can be interpreted by the onboard autonomy controller. The question therefore is how does one translate the knowledge accumulated over the years from manned platforms to the case of unmanned platforms, which may not require the same type functions as the manned platforms since the unmanned platforms put less at risk without the exposure of the warfighter in harms’ way. However, the cost of such platforms is not insignificant and the type of missions they are designed to perform require sophistication and decision making which can be challenging without the human in the loop. Even something as large as an XLUUV may have limitations on the available power and space that would preclude replicating what is on manned platforms. Even without the space and power limitations, can the autonomy controller onboard these unmanned platforms ever reach the same level of sophistication that it can handle the same level of decision making process and acting provided by the onboard human interpreting the data. A different way of thinking to handle



Lockheed Martin XLUUV

the unmanned platforms is therefore necessary. The reduced real estate for the sensors will influence the sensor selection and capability. Smaller sensors do not give the accuracy in the bearing estimates, and the loss of low frequency sensitivities may reduce classification capabilities. Deriving range from the bearing estimates will potentially require complex autonomy functions, the concept of the autonomy controller handling target motion analysis to derive range and thus help with threat and obstacle avoidance cannot be just derived from what is common on manned platforms.

Sensor space is not the only limitation, if it was possible to replicate the sensor suite on an unmanned platform, there may not be enough processing power to process the data from all the sensors. Array sizes and number of channels have to be reduced to match the available processing power. Reduced channel count, focused signal processing and autonomy to handle the interpretation of the data products that come out of the processing for unmanned vehicles that can go hundreds of miles is a challenge for the very near future. Some of these developments are already in progress as Phase I of the XLUUV program (PMS406) is quickly coming to completion with two very capable designs that meet most if not all of the requirements and are achieved within the constraints of the two alternate platform designs.

However, there is always room for improvement and new technologies and approaches. New transducer materials and sensor designs, new forms of signal processing, efficient use of the data products created by the sensor and data processing consistent with the autonomy controller requirements are all anticipated to be focus areas to make unmanned platforms have the necessary capabilities to perform the anticipated missions of these platforms.



Boeing EchoVoyager UUV

FALL CONFERENCE CHAIR’S MESSAGE

ROBERT DUNN
CHAIRMAN

ERIC IRWIN
CO-CHAIRMAN

The fall conference theme, “Maintaining Dominance in the Undersea Domain during SSN gap years” focuses on the capabilities and gaps in the Navy’s vision for sustaining undersea superiority now and into the future.

This year’s outstanding group of plenary speakers represents the full spectrum of undersea warfare expertise. The plenary session will begin with our keynote speaker ADM Caldwell, the Director, Naval Nuclear Propulsion Program. Following him and throughout the day, briefs will be presented by the Commander, Submarine Forces; Principal Military Deputy to ASN/RDA; Deputy Chief of Naval Operations for Warfare Systems; Commander, Submarine Force, U.S. Pacific Fleet; Chief of Naval Research; Program Executive Officer Submarines; Program Executive Officer C4I; Program Executive Officer Air ASW Programs; Commander, Naval Undersea Warfare Center; Program Manager for Unmanned Systems, Office of Naval Intelligence, and the Director, Undersea Warfare Division, N97.

Attendance provides you the opportunity to gain insight into the challenges and capability gaps that the Navy faces across the entire spectrum of the undersea domain. Take advantage of this opportunity to hear our Defense and Navy leader’s views on the issues confronting the Navy-industry-academia team as we navigate the waters of an uncertain future that will present new challenges to sustaining our undersea dominance.

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