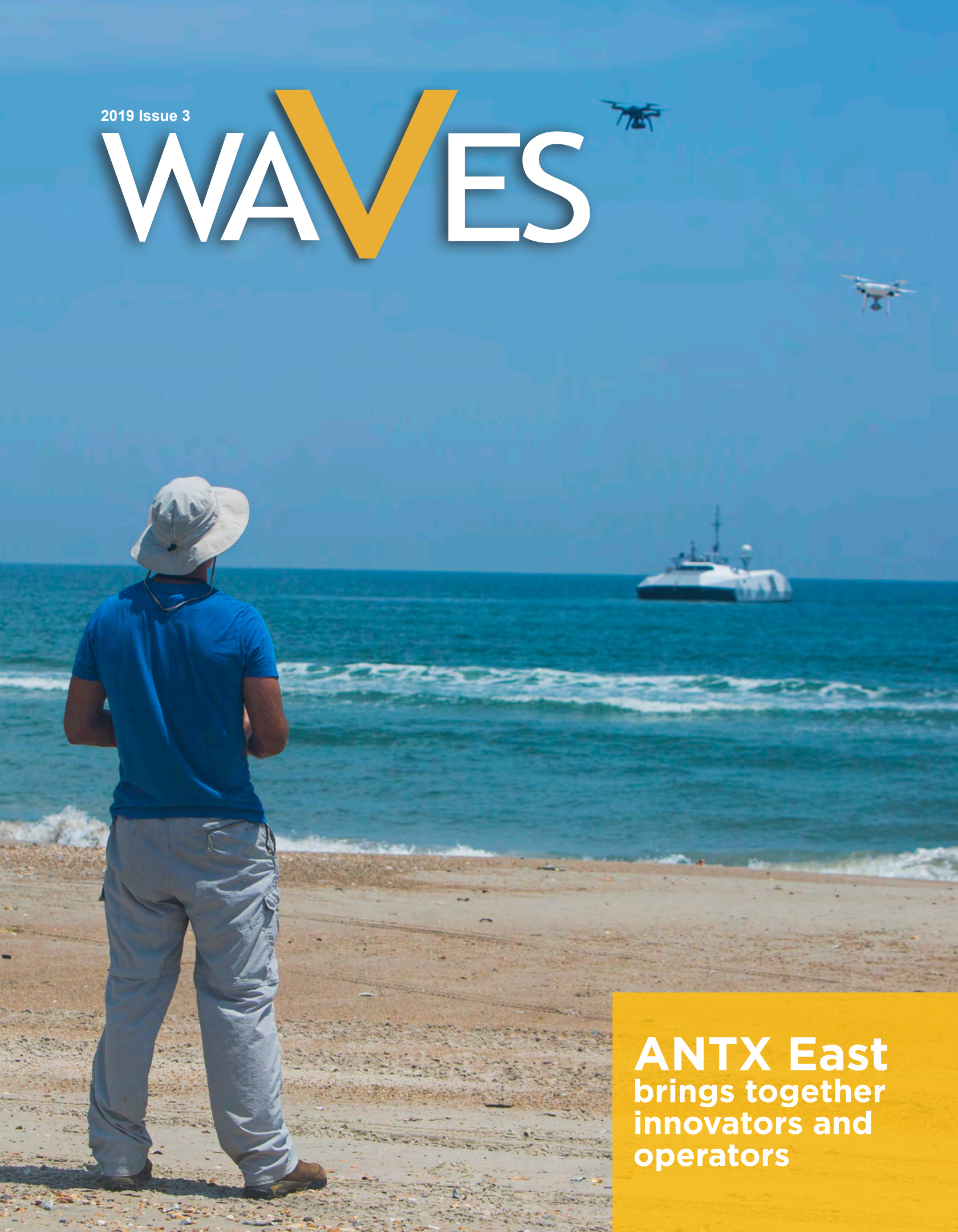
2019 Issue 3

WAVES



ANTX East
brings together innovators and operators

Content

WAVES

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In this issue

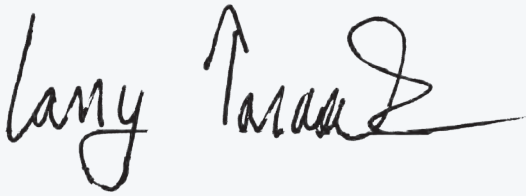
This summer was anything but quiet for Carderock, starting out with the International Human-Powered Submarine Races in June. If you haven't already seen the special edition of Waves that featured everything about one of the oldest international STEM operations in the Navy, you should check it out.

The cover spotlight for this issue of Waves is the Advanced Naval Technology Exercise (ANTX) that Carderock co-led with other Warfare Centers and the Marines in July at Camp Lejeune, North Carolina. ANTX East brought together government, industry and academia to the beaches and landing zones of Camp Lejeune, where more than 50 participating teams demonstrated new technologies to support our warfighters, specifically the Marines. Carderock showcased an autonomous unmanned surface vehicle and power and energy alternatives. Our Sea-Based Aviation Branch experts were also there to act as the adversary with their drones.

While Carderock was the technical lead for the 2019 ANTX East with the Marines, several other of our sister Warfare Centers helped organize the event, including Naval Information Warfare Center, Atlantic; Naval Undersea Warfare Center, Keyport Division; and Naval Surface Warfare Center, Port Hueneme Division. This displays the amazing spirit of collaboration and the Warfare Centers "One Team" mentality I see in our workforce every day. It's not only important for us to recognize the value and expertise each Warfare Center brings to the table, but also the talent and drive of our warfighters.

Looking to the next generation, we had a full summer of interns, some of whom had the opportunity to have their work demonstrated at ANTX. I love seeing these college and high school students come here and really work for the summer. They learn so much at a Warfare Center when they have the opportunity to be hands on, side-by-side with our world-class scientists and engineers. We look forward to many of them returning to Carderock after they graduate. Our future is bright.

As always, there's never a lack of inspiration at Carderock, whether it's with the people who are being inspired or the ones inspiring others. This summer was no exception. Every day is a good day at Carderock.



Cover

Owen McGarity, an engineer in the Sea-Based Aviation and Aeronautics Branch at Naval Surface Warfare Center, Carderock Division, pilots unmanned aerial systems (UAS) on July 15, 2019, at the beach on Camp Lejeune, North Carolina, during the Advanced Naval Technology Exercise (ANTX) East. As part of the Red Team, McGarity acted as the adversary for counter-UAS technologies that were being demonstrated. (U.S. Marine Corps photo by Cpl. Michael Parks/Released)

ANTX East brings together innovators and operators

Kelley Stirling
NSWCCD Public Affairs

Naval Surface Warfare Center, Carderock Division co-led the third of three Advanced Naval Technology Exercises (ANTX) for "Fight the Navy Force Forward" July 9-19, 2019, at Camp Lejeune, North Carolina.

Dubbed ANTX East, the event focused on command and control, communications, force protection, unmanned systems and logistics. While Carderock was the technical lead for the event, there were three other Warfare Centers involved in coordinating the technologies: Naval Information Warfare Center, Atlantic; Naval Undersea Warfare Center, Keyport Division; and Naval Surface Warfare Center, Port Hueneme Division. The Marine Corps Warfighting Lab worked with the technology organizers to develop mission threads that were realistic to the Marines.

Rod Peterson, Carderock's Marine Corps Vulnerability and Protection Program manager and lead organizer of the event, said ANTX provided an opportunity to test prototypes and to participate in an interactive and progressive series of exercises in a collaborative and low-risk environment. Last fall, government and industry vendors submitted the technologies they wanted to test during ANTX.

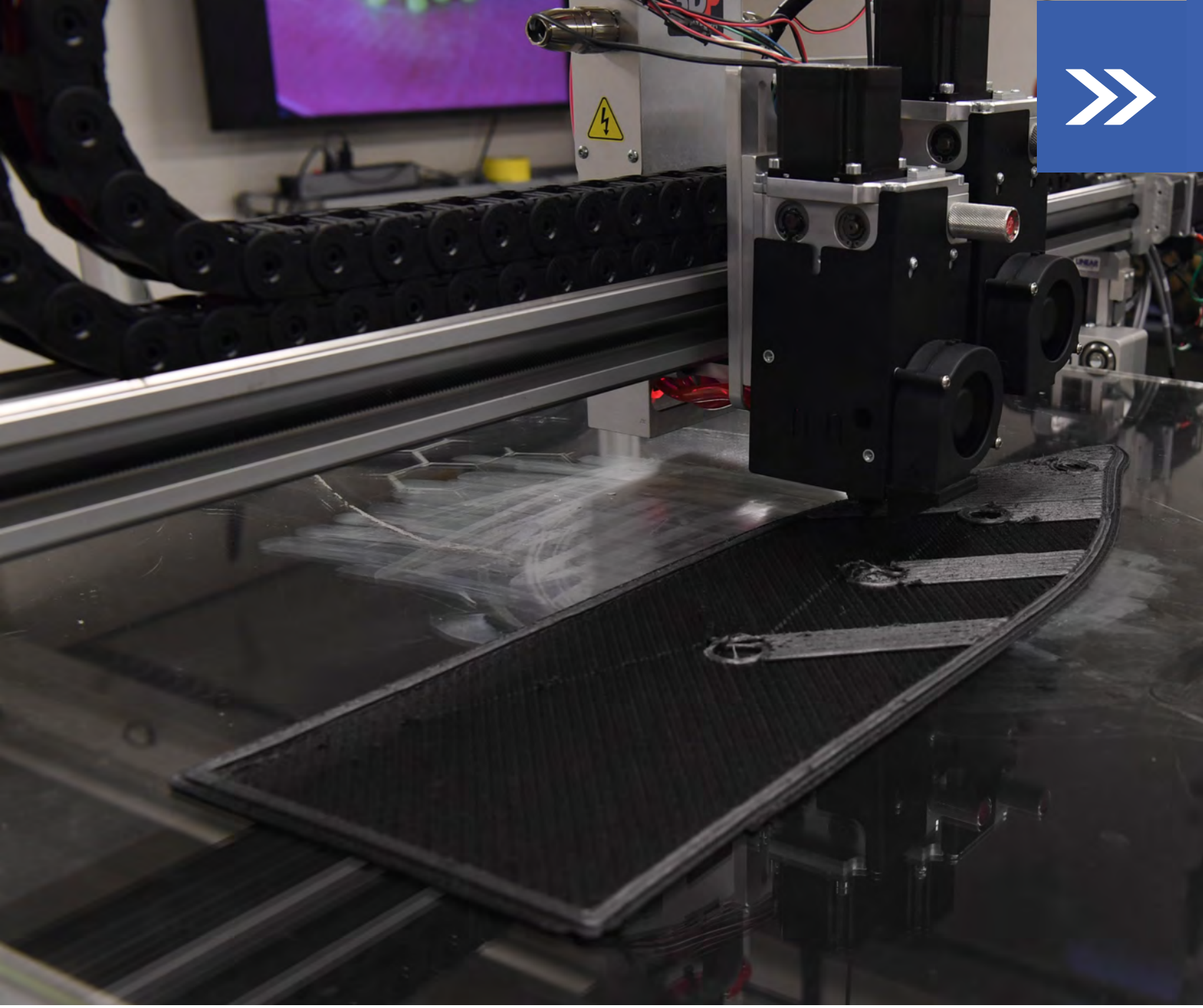
"We have about 32 organizations with 53 technologies from industry, academia and government," Peterson said. "ANTX allows us to bring together the technical community and the operational community for tech assessments in one location."

Sam Pratt (right), an engineer with the Advanced Manufacturing Project Office at Naval Surface Warfare Center, Carderock Division, talks with Marines as they demonstrate 3D printing in the Expeditionary Fabrication facility on July 17, 2019, during the Advanced Naval Technology Exercise (ANTX) East in Camp Lejeune, N.C. (U.S. Navy photo by Kelley Stirling/Released)

Carderock had several technologies at Camp Lejeune during 90-plus degree heat. Combatant Craft Division (CCD), a detachment of Carderock, had multiple vessels on the water in Mile Hammock Bay. The Stiletto Maritime Demonstration Program platform was a key facilitator for about a third of the technologies at ANTX East, according to Kenneth (Kip) Davis, site director for CCD, which is located in Norfolk, Virginia.

Combatant Craft Division demonstrated an autonomous unmanned surface vehicle (USV) during the event, showcasing the boat's ability to hold a position and sense its environment to perform a flawless docking at the pier.

Dr. Julie Stark, the science and technology manager for CCD, said the boat is a USV Lab Afloat, demonstrating autonomous safe navigation. She said it is a key component of the USV Autonomy Lab and Integration Center, which allows CCD to do research and development



(R&D) for the Navy, Marine Corps and other Department of Defense partners.

One of the key components to ANTX East was the operator, in this case the Marine Corps. Having their instant feedback was crucial, according to Stark. She said the exercise allowed them to rapidly identify technologies that might fill gaps where the Navy or Marine Corps need them. They used mission threads developed by the Marine Corps Warfighting Lab (MCWL) for the event.

Garry Shields, director of Carderock's Disruptive Technologies Lab, brought some of his team's unique ideas to ANTX East, such as a manufacturing forward capability.

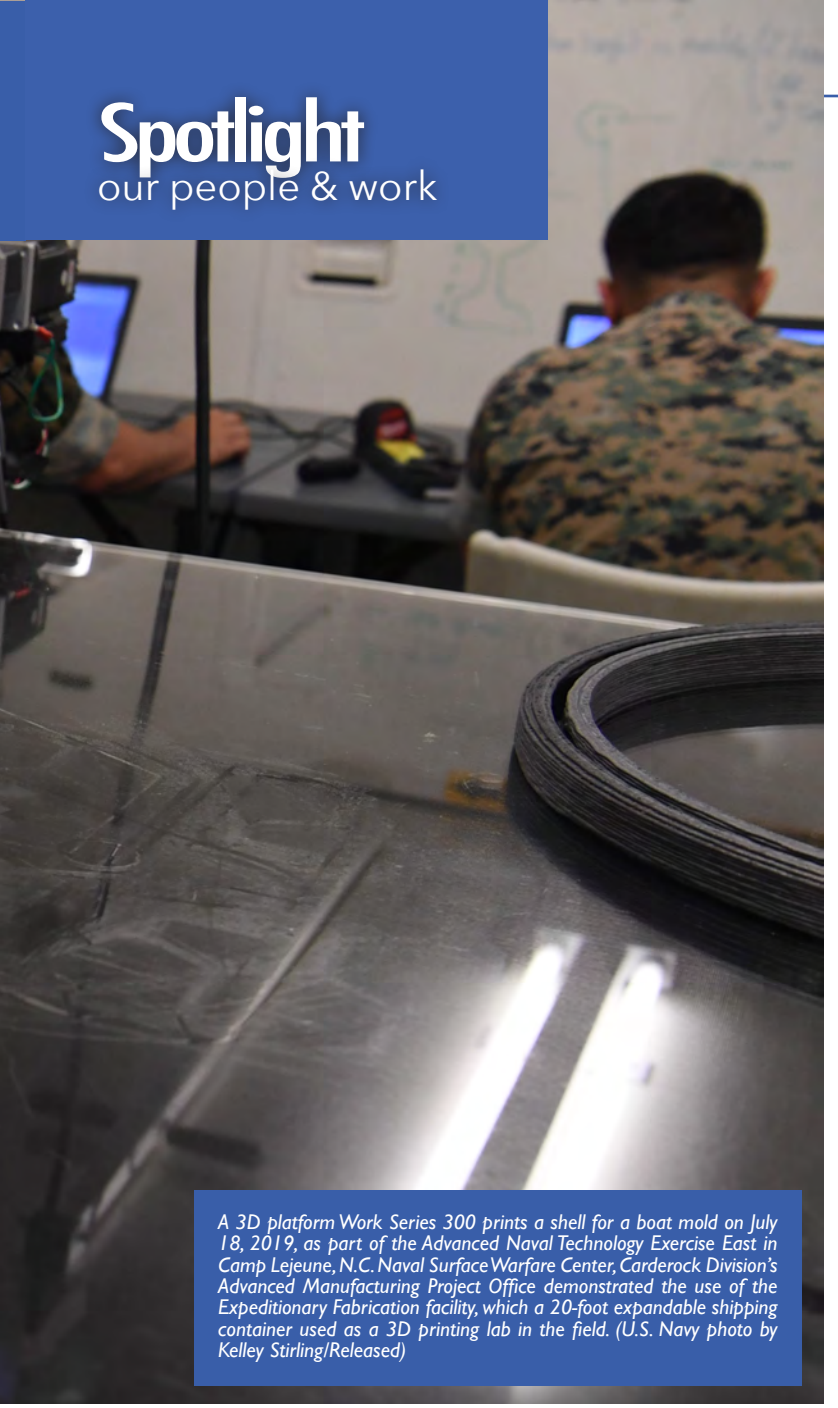
"We are demonstrating a new form of asymmetric industrial warfare, particularly the ability to build tactical systems at the speed of relevance," Shields said.

In basic terms, his group was showing the Marines how they can improvise to build necessary items by using materials they may already have on hand, rather than waiting for the acquisition process.

"It's been transformative for us, and we think it's transformative throughout the Marine Corps when we start thinking about how we will build an improvisation network of technologies and Marines that know how to build transformative things in real time," Shields said.

Another manufacturing forward idea was brought by Carderock's Additive Manufacture Project Office, which showcased the Expeditionary Fabrication (ExFab) facility. Basically an expandable, 20-foot shipping container, the ExFab is fitted with several 3D printers to allow for rapid parts manufacturing.

"It enables us to set up a 3D printing lab anywhere in the world on the fly to make a rapidly deployable fabrication facility, which is a really unique capability in terms of the advanced manufacturing lab," said Carderock's Sam Pratt, a trainer and technical expert in the ExFab facility.



A 3D platform Work Series 300 prints a shell for a boat mold on July 18, 2019, as part of the Advanced Naval Technology Exercise East in Camp Lejeune, N.C. Naval Surface Warfare Center, Carderock Division's Advanced Manufacturing Project Office demonstrated the use of the Expeditionary Fabrication facility, which a 20-foot expandable shipping container used as a 3D printing lab in the field. (U.S. Navy photo by Kelley Stirling/Released)

As technologies were demonstrated, the operational component was able to identify additional needs, and some technologies came together to address those needs, and the researchers ultimately changed their demonstration during the exercise.

"There's nothing that can't be solved when you get the right people in the room, who all come with a purpose and a sense of humility," said James Geurts, the assistant secretary of the Navy for research, development and acquisition, during his visit to ANTX East on July 18.

John Phillips, the Marine Forces Command science advisor for the Office of Naval Research, said ANTX has allowed the operator to see how an idea can become a capability.

"Once you can see something in an experiment, the vision is there," Phillips said, adding that being able show the capability of something, beyond the science and technology, makes ANTX an important event. "When you get it in front of a Marine, they are asking questions that are different. They are asking questions about capability, and that's what the scientists and engineers should care about."

Carderock Technical Director Larry Tarasek said ANTX provided a means for interaction between the scientists and engineers and the warfighter.

"The technologies we are seeing are fantastic," Tarasek said. "But it's not just about the technology; it's about bringing the fleet here and getting their feedback."

Prior to the event, Carderock established Cooperative Research and Development Agreements (CRADAs) with every technology demonstrator, which means a technology that the Marines thought would be immediately useful can transition to the force immediately, either for acquisition or further research.

"It really does enable rapid fielding of technologies in a way that hasn't been done before," Stark said.

Technology assessors scored the different entries throughout the week, and as part of the phase two of ANTX East, they will determine if there is potential for further development of any of the technologies demonstrated.

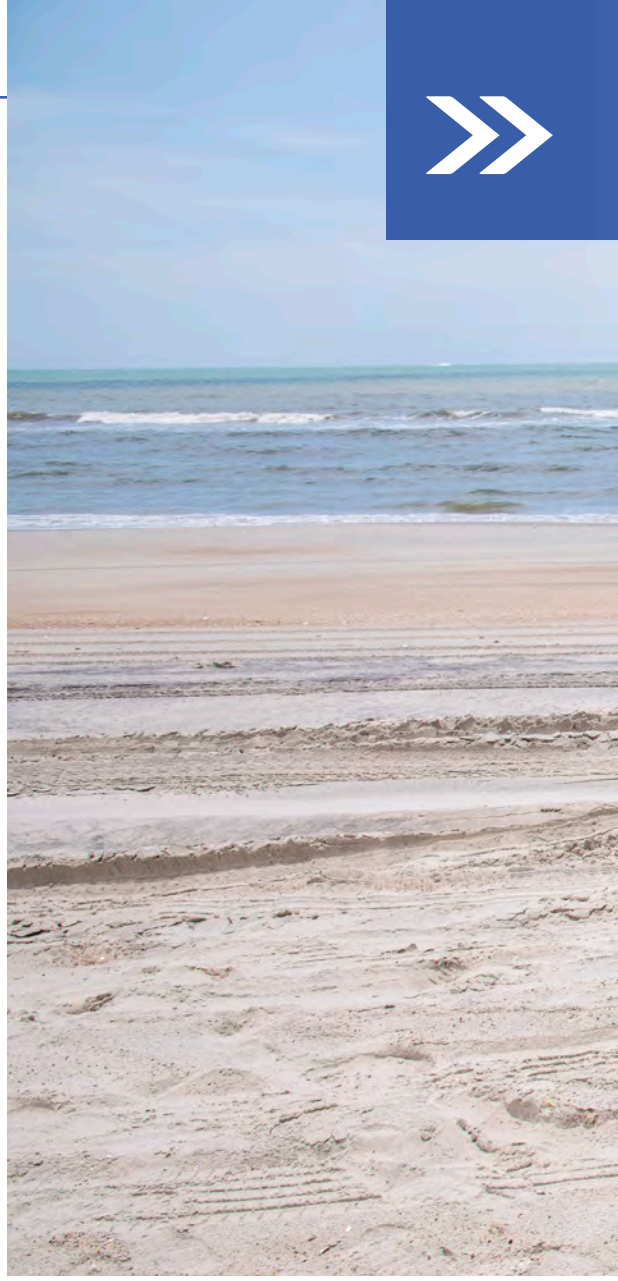
Selected participants will be invited to phase two, which includes a six- to 18-month follow-on development process, where they will continue experimenting and prototyping their projects. Successes from phase two may then end up with a contract package.

Assistant Commandant of the Marine Corps Gen. Gary Thomas said the bottom line is the Marines need new capabilities for their concept of operations to work and that they need them quickly.

"What's exciting from my perspectives is the agility that a venue like this provides us," Thomas said of ANTX during his remarks. "This is extremely high value."

Carderock's Red Team is ANTX East adversary at Camp Lejeune

By Kelley Stirling, NSWCCD Public Affairs



During the Advanced Naval Technology Exercise (ANTX) at Camp Lejeune, North Carolina, in July, vendors and government entities demonstrated their technologies to the Navy and Marine Corps in the areas of command and control, communications, maneuver, logistics, force protection and unmanned systems.

As part of the force-protection demonstrations, several technologies focused on counter-unmanned aerial systems (UAS). Naval Surface Warfare Center, Carderock Division's UAS Lab, part of the Sea-Based Aviation and Aeromechanics Branch, participated by acting as the adversary.

The four-member Red Team was responsible for mission planning with the vendors and piloting the commercial off-the-shelf and custom drones that the counter-UAS technologies were targeting. Owen McGarity and Jared Soltis were the primary pilots, Eric Silberg was a secondary pilot and Kevin Kimmel was a pilot in training and UAS maintainer.

"Our role as Red Team was to challenge the contractor technologies that were being demonstrated and provide a certain amount of government perspective on the actual capabilities of the technologies," McGarity said.

Flying from the beach or the Bluebird landing zone inland, McGarity and Soltis piloted their drones so they could push the limits of the technologies, which were ground-based systems mounted on either a vehicle or a boat.

"It wasn't just the contractors flying against their own technologies," McGarity said. "We were able to provide some amount of an independent and unbiased check on what they were bringing to the table."

As part of the ANTX, the technologies were observed and reviewed by Navy and Marine Corps operational and technical assessment teams. These teams had a limited amount of time with each technology before making their assessment. McGarity and Soltis spent the entire several-day exercise with these teams, really getting to know the technologies.

"We were embedded with these technologies," Soltis said. "We had a very good sense of what they could and couldn't do."

Soltis said they also filled out the assessment sheets since they had such an in-depth knowledge of how the systems worked.

There were two primary types of counter-UAS technologies that the Red Team was flying against, according to McGarity. One of these was a jammer that overwhelms the video and control signals to the UAS.

"You completely lose control, the video goes out, the command-and-control link from the transmitter controller goes out and the aircraft is left to figure out what to do on its own," McGarity said, adding that it will generally follow its fail-safe protocol and return home.

He said the other counter-UAS technology was able to target specific aircraft.

"I was impressed by one of the contractor's ability to selectively identify, take over and redirect what the aircraft would do," McGarity said. "That's really the forefront of the development. If you're going to be deploying this technology, either at an airport or on a battlefield, you don't want to be taking out everybody with a broad-based jammer, because you're going to have friendlies. That's what we saw as room for improvement for a lot of the contractors, was developing this library of aircraft to be able to take down selectively."

This wasn't the only ANTX the Red Team has been a part of. Last year at Camp Pendleton, California, Silberg, Carderock's UAS Lab director, flew for the Red Team and Soltis was a technical assessor. While Silberg's primary role at Camp Lejeune was as focus-area lead for unmanned systems, he was also able to assist the Red Team as an additional pilot during larger demonstrations.

To fly drones as part of Carderock's UAS Lab, Silberg implemented a pilot-certification process. Potential pilots

From left: Owen McGarity, Jared Soltis and Kevin Kimmel, engineers in the Sea-Based Aviation and Aeronautics Branch at Naval Surface Warfare Center, Carderock Division, prepare to fly unmanned aerial systems (UAS) on July 13, 2019, during the Advanced Naval Technology Exercise (ANTX) East at Camp Lejeune, North Carolina. As part of the Red Team, they acted as the adversary for counter-UAS technologies that were being demonstrated. (U.S. Navy photo by Joseph Bullinger/Released)

at Carderock have to pass medical requirements, take ground-school training and demonstrate proficiency with the types of aircraft that they will be certified to operate. Soltis and McGarity were the first Carderock engineers designated as UAS pilots.

"It certifies us to fly at a military installation. We have to be cleared, in the case of ANTX, by the air boss," McGarity said, adding that the airspace on a military installation is tightly controlled with limits on the altitude they could fly to, as well as the spatial area they could operate in.

The process for pilot certification at Carderock is fairly new and a work in process for the Warfare Centers. The basic construct is that an aircraft reporting custodian (ARC) is designated, similar to a squadron commander, who manages the program for a particular command. Silberg is Carderock's ARC and is authorized to operate small, "group 1-2" aircraft, which are generally under 55 pounds.

For ANTX, the Red Team "hangar" included 3DR Solos, DJI Phantom 4s, Parrot Discos and DJI F450s. These UAS were a mix of Carderock, Marine Corps and vendor vehicles and included both multirotor drones and fixed-wing aircraft. In addition to these, the UAS Lab has a variety of custom and commercial off-the-shelf aircraft.

"We can fly as a service to other folks on base, say if someone has a sensor or widget they want to take airborne, we can fly it for them," Soltis said. "We also do our own research. We did our first flight in the MASK (Maneuvering and Seakeeping Basin), flying some micro-quadcopters around to test out the radio-frequency interference and the aerodynamics in the facility."

McGarity said their aviation work ties into Carderock's ship research.

"If you think about a lot of the work we do in the MASK, ship survivability, ship motion, we are trying to get the unmanned aircraft to land and integrate with the ships," McGarity said.

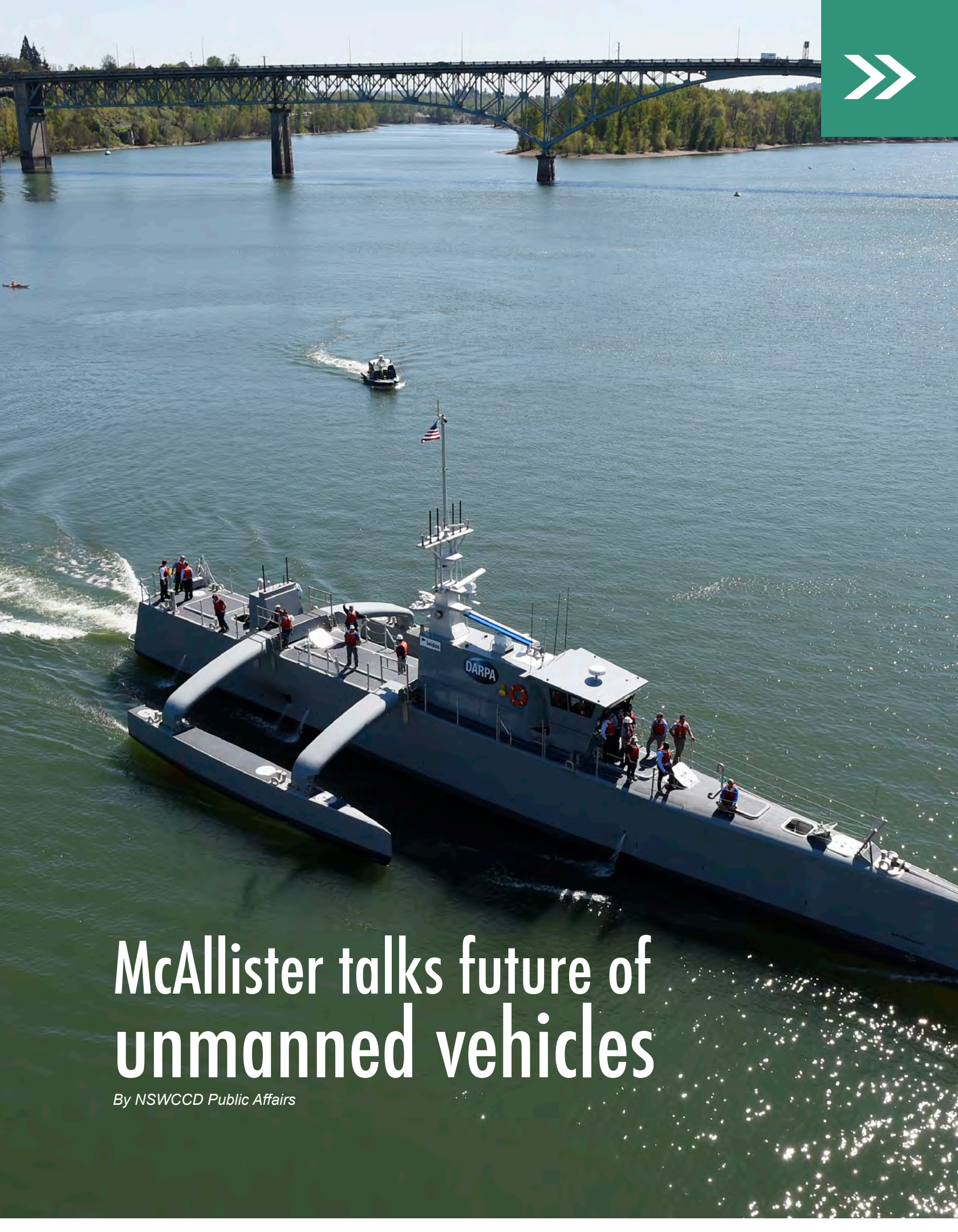
Note: The Carderock UAS Lab was featured in a YouTube video at: https://www.youtube.com/watch?v=XeaVDchmcJo&list=PL7WRGH6pAuScIQGZu3wW1MiFrWWBkz_mS&index=8

To see the ANTX East overview video, click here: https://www.youtube.com/watch?v=Xnz1oXgZbT8

Video features Welding Automation Lab

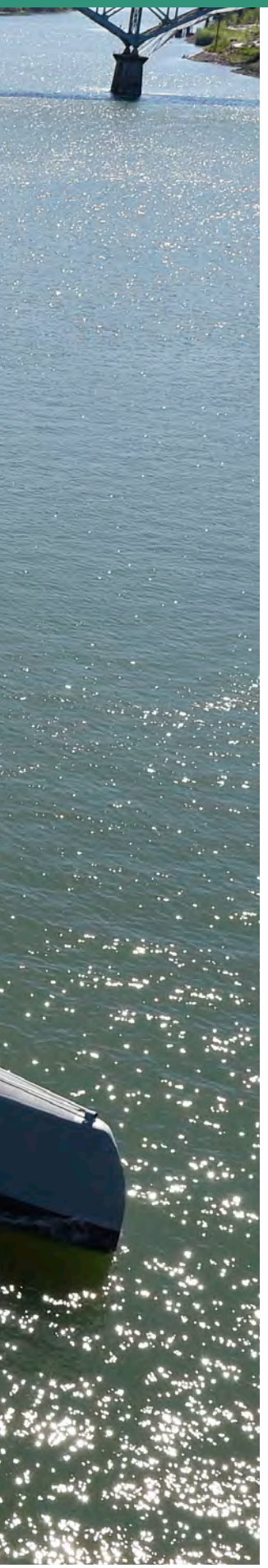
Gregory Nehl, a welding engineer in the Welding, Processing and Nondestructive Evaluation Branch, evaluates a robotic weld in the Welding Automation Lab at Naval Surface Warfare Center, Carderock Division. This image is taken from one of the Features and Spotlights videos on Carderock's YouTube page. Check it out here: https://www.youtube.com/playlist?list=PL7WRGH6pAuSclQGZu3wW1MiFrWWBkz_mS. (U.S. Navy video by Nicholas Brezzell/Released)

Innovation
at work



McAllister talks future of unmanned vehicles

By NSWCCD Public Affairs



Before the turn of the century, futurists imagined today looking something like an episode of "The Jetsons," with robots doing the dull and dirty work in every home, and pilotless flying cars providing seamless transportation. While that is certainly not the case yet, futuristic concepts are being developed and tested at Naval Surface Warfare Center, Carderock Division.

Reid McAllister is the director of Carderock's Integrated Unmanned Maritime Mobility Systems, which is responsible for the research, development, test and evaluation of unmanned maritime systems and enabling technologies. McAllister said he knew years ago that unmanned systems would be a big part of future warfare, and he began coordination efforts to establish an unmanned systems community of interest across the Navy's Warfare Centers, laboratories, Systems Commands, academia and industry.

In 2015, Carderock Division and Naval Undersea Warfare Center, Newport Division started the Unmanned Vehicles and Autonomous Systems (UVAS) Working Group, co-led by McAllister and Newport's Chris Egan, with the idea to create a thriving, high-velocity learning enterprise to collaboratively exploit the Warfare Centers' collective technical capabilities and ensure the Navy has the most reliable and cost-effective unmanned systems.

"The focus of the UVAS Working Group is not just about developing unmanned systems technology alone," said McAllister. "It's also about integrating unmanned systems and related technologies into the naval force to achieve force-multiplying capability through dynamic man-machine teaming."

According to McAllister, the future of unmanned systems success hinges on the ability to rapidly advance autonomy development and the speed at which the Navy can safely transition those advancements to the fleet.

Unmanned systems that are 100 percent autonomous need to have the ability to function on their own when communications with the remote operator are lost. Different types of maritime platforms have distinct communication limitations and those variables have to be accounted for. Undersea systems cannot use radio frequencies for routine communications when submerged, while surface platforms can communicate as long as over-the-horizon links are maintained. When unmanned systems go into hostile environments, they must have the ability to continue with the mission.

Reliance on autonomy becomes critical to system adaptability and mission success. If a system's autonomy/sensor fusion is smart enough to be able to perceive the dynamic world it is operating in and react accordingly, the need to place warfighters' lives on the line to complete a mission is greatly reduced, if not eliminated.

Unmanned systems could play a role in peacetime scenarios, as well. A ship with a Sailor or Marine overboard could launch an autonomous boat with a recovery crew aboard. The smart boat could have advanced infrared perception as part of its autonomy sensor suite, which would allow it to see the human as a hot spot against the backdrop of the cold sea. The Sailors aboard the rescue craft would not have to focus their attention on the safe navigation of the boat, but on the safe and quick return of the Sailor or Marine to the ship.

"That is a good example of man-machine teaming," McAllister said.

The UVAS Working Group meets weekly. Representatives from across the Naval Research and Development Establishment map out how to best apply their collective energies to advance unmanned systems and warfighter capability.

Capt. Pete Small, head of the Unmanned Maritime Systems Program Office (PMS 406) at Naval Sea Systems Command, is stewarding a multi-billion budget to acquire significant numbers of unmanned maritime systems and related core technologies over the next five years. Small approached the UVAS Working Group to help him understand how the Warfare Centers, Naval Information Warfare Center Pacific and Naval Meteorological and Oceanographic Command could come together to assist in the development, testing, fielding and sustainment of the PMS 406 unmanned systems portfolio. There is urgency in Small's request since many of these capabilities will be coming into Navy possession within the current Future Years Defense Program.

To accelerate understanding and collaboration, the UVAS Working Group facilitated a workshop on March 22 at Carderock to discuss the development, testing, fielding and sustainment of the PMS 406 portfolio. During breakout sessions, teams brainstormed their ideas to explore the gaps and opportunities for unmanned systems in the areas of core technologies; business and acquisition; integrated logistics support; test and evaluation; ashore and afloat facilities; and sustainment.

Small said he intends to use the results of the workshop as a foundation for a series of ongoing collaborative efforts that will expand outward to other organizations, ensuring the success of PMS 406's portfolio across the life cycle.

"How do we develop unmanned systems far cheaper than we currently are producing them today, and how can we affordably assemble, field and operate multi-domain systems in large numbers?" McAllister said. "When you deploy low-cost capability en masse at an adversary, the cost imposition shifts against the adversary, and our superiority in every encounter is the most likely outcome. Expendability should be a key driver where it makes sense."

Sea Hunter, an entirely new class of unmanned ocean-going vessel gets underway on the Williammette River following a christening ceremony April 7, 2016, in Portland, Ore. (U.S. Navy photo by John F. Williams)

Carderock hosts 2019 ISEA of the Future Forum

By Benjamin McKnight III,
NSWC Carderock Division Public Affairs

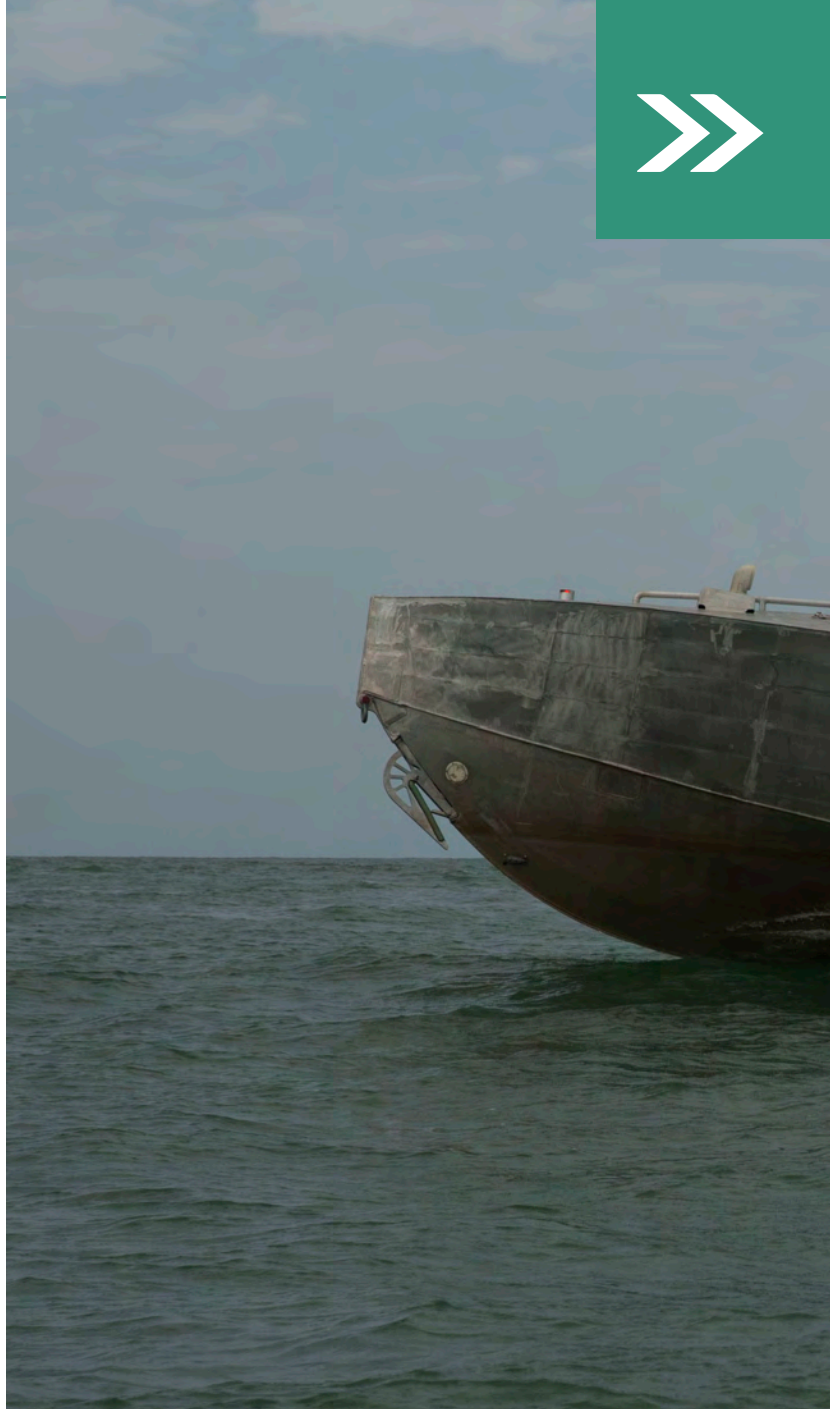
The Navy's Warfare Centers are actively working to embrace the future of the fleet and in June, Naval Surface Warfare Center, Carderock Division played its part by hosting an In-Service Engineering Agent (ISEA) of the Future Forum.

With a focus on digital twin, model-based systems engineering, live-virtual-constructive approaches and autonomy/unmanned systems, the two-day event June 19-20 featured a wide array of guest lecturers and panelists facilitating in-depth discussions on highlighted topics.

"ISEA of the Future is an initiative where we look to identify tools and processes that will enable our engineering agents to more effectively do their job and support the fleet," said Dr. David Drazen, digital twin program manager in Carderock's Scientific and Technical Liaison Branch. "We are hoping to leverage advancements such as data science, additive manufacturing, augmented and virtual reality and autonomy to increase operational availability of the fleet while minimizing cost."

Naval Surface Warfare Center, Port Hueneme Division's technical director Paul Mann opened both days with overviews of the ISEA vision. Capt. Steve Murray, the Navy's Major Program Manager for Surface Ship Readiness, accompanied Mann on the first day and provided the audience with a service member's perspective of the ISEA goal. A keynote address from Rear Adm. Doug Small, Program Executive Office for Integrated Warfare Systems, headlined the second day of sessions that welcomed industrial and academic contributors to the Navy's, along with the Department of Defense participants.

"What I am most passionate about is the people behind what we do," Small said. "Our ability to be the best Navy in the world for a long time is because of our ability to take the latest and greatest technology and put it into the hands of the greatest Sailors in the world."



One of the ideas in the umbrella of Small's reference to the latest and greatest technology is the utilization of autonomous and unmanned machines. Carderock's Reid McAllister in the Unmanned Vehicles and Autonomous Systems (UVAS) Working Group hosted the first of two unmanned/autonomous systems panels on day one. The following day, Navy veteran and director of University of Maryland UAS Test Site Matt Scassero delivered a UAS-focused lecture titled "Multi-domain and Seamless Communications."

Scassero's primary message was on the importance of creating secure and efficient methods of communicating to unmanned and autonomous systems. According to him, giving these systems longer ranges and the ability to operate more independently from humans requires complex communication methods rather than the point-to-point radio frequency traditionally used in unmanned machines. Along with the advancement, though, Scassero said there should be adequate means to safeguard the messages and data transferred.

An expeditionary warfare unmanned surface vessel (USV) autonomously navigates a predetermined course during Advanced Naval Technology Exercise (ANTX) East 2019 at Camp Lejeune, N.C., July 12, 2019. ANTX East 2019 is an event designed to test new technology with acedemic, industry and Navy participants. (Marine Corps photo by LCpl. Nicholas Guevara/Released)

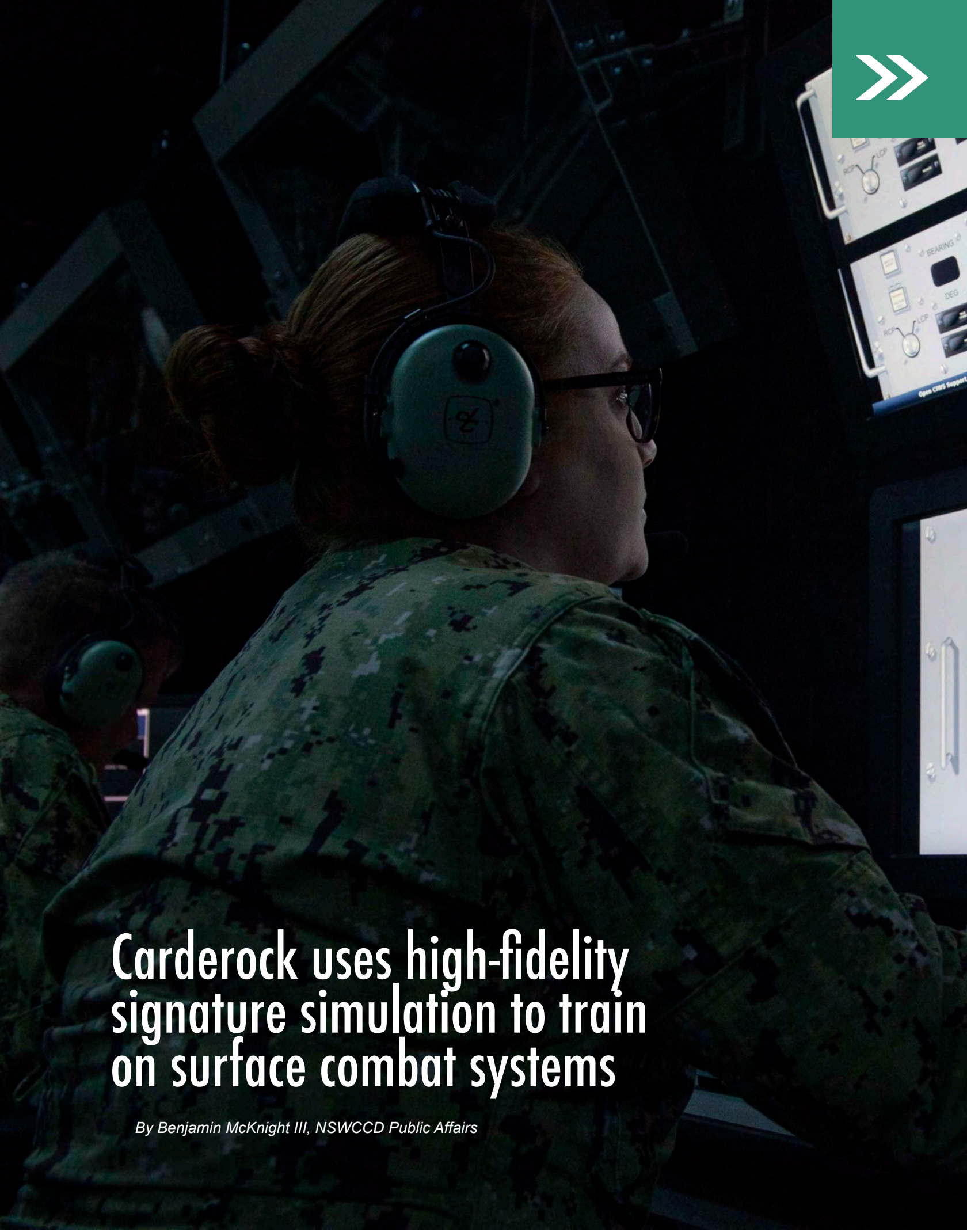
"Cyber security is pushing us to have more secure communications systems, not only for safeguarding the data itself, but also the quality of the data, to make sure people can't actually hack into our systems," he said.

To convey the progress made in the UAS arena thus far, Scassero told the story of the first-ever delivery of a human organ on an unmanned aircraft that took place in April. The 10-minute flight from the Living Legacy Foundation in downtown Baltimore to the University of Maryland Medical Center displayed the realistic possibility of the using autonomous systems to transport supplies to Navy platforms.

Both days also featured multiple sessions on the digital twin concept. Dr. Ryan Coleman and Maxwell Danik from the Sandia National Lab gave a presentation on day two highlighting ways that engineers could use multiple technologies to build and upkeep a digital twin program. Within their lecture, Coleman and Danik showed how a link between digital twin and model-based systems engineering and how Sandia implements these technologies to reduce the development cycle duration of nuclear weapons.

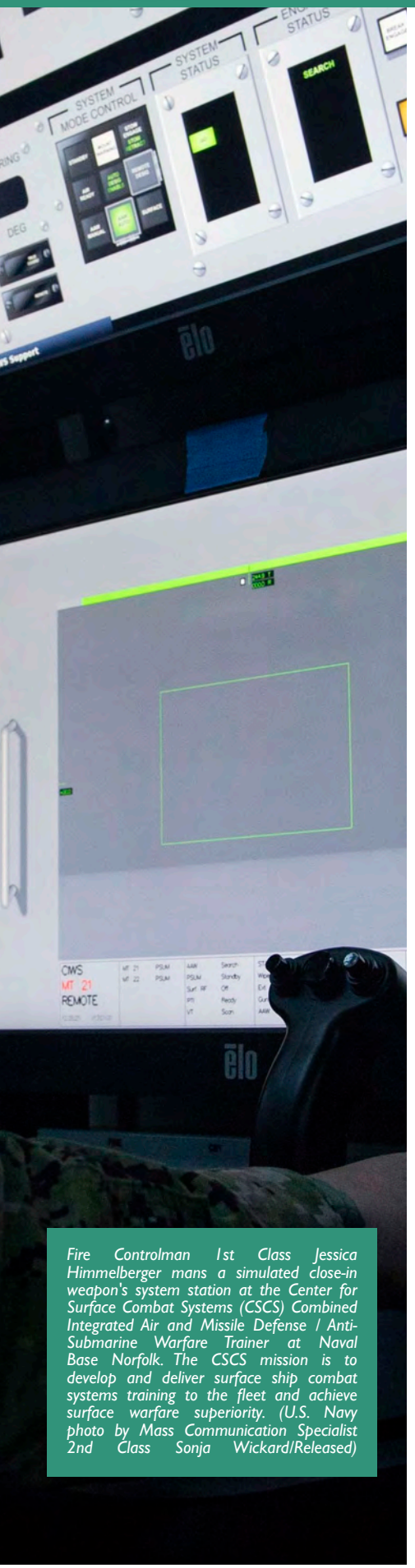
Creating the Navy of the future requires an all-inclusive effort from service members and civilians alike. With initiatives like those discussed over the course of the forum, Small is confident that ISEA is steering the Warfare Centers in the right direction.

"I've been to the future and it's awesome, because the ISEA of the future is awesome," Small said.



Carderock uses high-fidelity signature simulation to train on surface combat systems

By Benjamin McKnight III, NSWCCD Public Affairs



Fire Controlman 1st Class Jessica Himmelberger mans a simulated close-in weapon's system station at the Center for Surface Combat Systems (CSCS) Combined Integrated Air and Missile Defense / Anti-Submarine Warfare Trainer at Naval Base Norfolk. The CSCS mission is to develop and deliver surface ship combat systems training to the fleet and achieve surface warfare superiority. (U.S. Navy photo by Mass Communication Specialist 2nd Class Sonja Wickard/Released)

In the world of simulations, getting a system to act as close to authentic as the real-world situations it represents is always the main goal. Naval Surface Warfare Center (NSWC), Carderock Division develops high-fidelity acoustic simulation and training systems, giving naval personnel the ability to practice combat scenarios virtually.

The Combined Integrated Air and Missile Defense (IAMD) and Anti-Submarine Warfare (ASW) Trainer, better known as CIAT, made its official debut in December 2018 at Naval Base San Diego. In June, Naval Station Norfolk became the site for another CIAT installation. Motions to create this trainer began in 2014, according to Rich Loeffler, Carderock's senior scientific technical manager, director for signatures, tactical decision aids and training systems.

"CIAT is what we refer to as a combat systems team trainer," Loeffler said. "Meaning that your goal is to bring in the whole portion of the crew that would be operating the combat system and train them in a shore site how they can best utilize the system when they are at sea."

Carderock shares CIAT responsibilities with NSWC Dahlgren Division. Dahlgren is responsible for the overall system integration and manages the IAMD aspect of the trainer, while Carderock leads the development of the acoustic and ASW capabilities. Carderock also has capabilities that contribute to the IAMD training. Using the periscope simulation that creates a real-time visual simulation of what one could see through the periscope of a submarine, Loeffler said they were able to utilize that technology for the surface ship trainer in the CIAT.

"In this case, they have deck cameras if they want to be able to see when a missile launches from the forward or aft launchers. We basically provide the visuals for that," he said.

By modeling the threats and the ocean environment and then stimulating the actual tactical combat system software, the CIAT system is highly flexible in the ability to train real-world scenarios. With the many possibilities of training situations that can be created within the CIAT comes the need to use multiple sources of knowledge to create effective training situations that will benefit the fleet.

"We'll work with people like the Office of Naval Intelligence to get threat intelligence data, we'll work with folks like the Naval Oceanographic Office to get the latest environmental models and databases, and then we'll work with the tactical programs themselves to get the tactical software," Loeffler said.

"Our role here at Carderock has been to leverage signature simulation capabilities we have developed over the years across submarine, surface and surveillance ASW trainers and provide the system design, development, integration and testing support to implement the CIAT requirement to support the fleet's training needs," he said.

Before the CIAT existed, the Surface ASW Synthetic Trainer (SAST) was developed by Carderock as an on-board embedded training system within the AN/SQQ-89 A(V)15 sonar system.

Loeffler said beginning in 2008, they went through a series of large analyses to compare and contrast what the simulation produced with what operators saw at sea. The data from that testing helped further develop the SAST and subsequently create the CIAT. Now, they are able to represent all components of the operations they run from the physics modeling perspective, such as what sounds are generated and how they propagate through the water, interactions with interfering objects and sea-state effects on these variables.

"Since we're acoustically stimulating the actual tactical software of the sonar system, the users are operating the systems just as they would at sea," he said.

Loeffler believes that there is not anything off limits for what the CIAT can do, but adapting with new threats will require the right development within the trainer to represent the real-world situation. Although the system is relatively new, discussions on the next steps in the development of the trainer are already taking place with the help of Center for Surface Combat Systems (CSCS) defining and prioritizing fleet training requirements

"CSCS is basically the primary stakeholder that owns the surface-ship training schoolhouses, and they've done their requirements review to see what additional capabilities they'd like to see in the next version of CIAT," Loeffler said. "So, we're going through that process, assessing those requirements and looking for what would go into the next version to further improve training and

Carderock's composite-patch technology is an alternative repair method for sensitized aluminum

By Brooke Marquardt and Kelley Stirling, NSWCCD Public Affairs

John Noland (left), an engineer in the Structures and Composites Division at Naval Surface Warfare Center, Carderock Division, and Lt. Aaron McGee, a student with the Naval Post Graduate School, prepare laminate material for a composite patch repair on USS Cape St. George (CG 71) in 2011. (Photo provided by Dan Hart/Released)

In a research lab such as Naval Surface Warfare Center, Carderock Division, a "win" is to see one's research applied in real life. For engineers Daniel Hart, John Noland and Bruce Wells, not only have they been involved in the development and application of their research, but they have also transitioned it to the fleet.

In 2010, this team out of Carderock's Structures and Composites Division received funding to find a non-welded repair for stress-corrosion cracking in highly sensitized aluminum that was happening on Ticonderoga-class cruisers. Leveraging international cooperation and previous experience from the Royal Australian Navy (RAN), they designed a fracture-mechanics-based bonded repair to address the cracking issue on the cruiser's superstructure.

According to Hart, the original reason for the composite patches was aluminum sensitization and the corresponding degree of sensitization, which is caused by the aluminum alloy being exposed to heat and a corrosive environment. There are four basic levels of sensitization: unsensitized; sensitized, but weldable; sensitized and weldable, but requires some type of cold work; and, above a certain level of sensitization, the metal is unweldable.

"Most of the plates we've come across have been on the high side of sensitized, but weldable with cold work to unweldable," Hart said. "Welding aluminum plate is a detailed and technical process, made more difficult when the material has sensitized."

The first ship the Carderock team installed the repairs on in late 2010 was USS Port Royal (CG 73). Hart said they had some issues on that first repair, but they were able to learn quickly from the problems.

"We learned a lot about our surface prep and discovered a couple of things, not only about the way we were treating and abrading, but also about the effects a shipboard environment has on our original surface preparation chemicals," Hart said.

In a traditional stress crack on a ship, welding might be the best solution. However, Hart said that this composite patch allows them to make repairs to stress-corrosion cracks in difficult places. Composite patches typically only require access from one side of the structure and generally do not require the removal of equipment, wires, ventilation, insulation, plumbing or weapons systems. Welding requires not only the removal of the equipment and cracked plate, but also removal of enough highly sensitized plate to reach weldable plate. Welders then have to install the replacement metal and post a fire watch throughout the welding process.

All of this adds up to a lot of money. Hart estimated that their composite-patch repair has saved the Navy anywhere between $1 million and $4 million per repair for several of the larger repairs.

One such repair was an emergency repair on USS Normandy (CG 60) to stabilize a 10-1/2-foot crack and four cracked longitudinal stiffeners. Normandy was the third Ticonderoga-class cruiser assigned to a Baltic Sea exercise in 2012 with no alternative asset available after two sister ships in the class were unable to support the mission. Before the ship could deploy, a repair was needed to restore structural integrity to a cracked deck. As a direct result of the research done at Carderock, the composite patch team designed, negotiated structural technical warrant holder (TWH) approval and installed a hat-stiffened composite patch in 21 days at a cost of $140,000. The weld repair estimate required more than six weeks at a cost of $1.5 million.

From 2010 to 2015, the investment in composite-patch science and technology was about $6.2 million, and it has resulted in greater than $30 million of maintenance cost savings across on 15 Ticonderoga-class cruisers and one Harpers Ferry-class dock landing ship.

This process is now an official temporary repair procedure approved by Naval Sea Systems Command (NAVSEA), and starting in 2017, the Carderock team began transitioning the composite-patch repair work to the Regional Maintenance Centers (RMC) for broad fleet use.

"We have been training the RMCs to install the composite patches, and that allows us to get back to focusing on the research side of it," Hart said. "That's really our goal for this transition."

Last October, the team was called to help the Southwest RMC do an emergency composite-patch repair on USS Mobile Bay (CG 53) with only three weeks to get the repair done, including designing it and getting the structural technical warrant holder approval. The damage and design process was very similar to the USS Normandy effort in 2012, however, this would be the RMC's first attempt at a repair.

"That was a really fast turn-around, and it was a complicated repair," Hart said, adding that team members Wells and Anna Bernal, an engineer with Carderock's Non-Metallic Materials Research and Evaluation Branch, went to San Diego to provide oversite and support for the repair.

Somewhere in the neighborhood of 100 repairs later, Hart said they went back to Port Royal in 2019 while it was in a maintenance availability at Pearl Harbor Naval Shipyard. However, this time, they taught the RMC how to install the repair. Composite-patch installers from both Southwest RMC and Pearl Harbor's fleet maintenance facility-surface (FMR) worked together to do some large and logistically complicated repairs, as well as complete their installer qualifications. That repair effort qualified seven RMC and FMR installers under the newly developed composite patch qualifications developed by Carderock and NAVSEA.

Hart said they have memos with Commander Navy Regional Maintenance Centers and the individual RMCs outlining the requirements for installer qualification, inspection procedures and maintenance of the composite-patch repair, which included attending a training course co-developed by Carderock and Gougeon Brothers. Gougeon Brothers is the manufacturer of the epoxy resin used for the repairs.

"We had worked with them (Gougeon Brothers) under some TIPS (Technology Insertion Program for Savings by Office of Naval Research) funding to set up what the course would look like, and ensured it covered all the aspects that we thought were important," Hart said, adding that they still provide oversite of the RMCs on the actual shipboard repairs. "Class is one thing, but having to coordinate all your materials, schedule, timing, get all the stuff on the ship, that's a whole other animal."

Susceptible to success: Tim Cullis wins the DOD Small Program Outstanding Tester Award

By Ryan Hanyok, NSWCCD Visual Information Branch

Believe it or not, even the clatter of a keyboard or the buzzing of a printer fan can affect a ship's acoustic signature. Tim Cullis believes starting his career measuring these "miniature" signatures led directly to becoming this year's winner of the Department of Defense Small Program Outstanding Tester Award.

Cullis was awarded this honor on May 29 in a ceremony at the Washington Navy Yard for directing multi-day, full-scale signatures testing at four different facilities across the continental United States in 2018. As the signatures test director for small craft and explosive ordnance disposal (EOD) equipment at the Naval Surface Warfare Center, Carderock Division, Cullis leveraged his experience to accomplish his mission.

Vice Adm. Thomas Moore (right), commander, Naval Sea Systems Command, and Rear Adm. Lorin Selby, deputy commander for Ship Design, Integration and Engineering, present Timothy Cullis, an electrical engineer in Carderock's Signatures Monitoring and Surface Ships Programs Branch, the Department of Navy Small Program Outstanding Tester Award during a ceremony at the Washington Navy Yard on May 29, 2019. (U.S. Navy photo by Laura Lakeway/ Released)

For over 50 years, Carderock has been measuring the signatures of big naval ships and submarines. Quantifying the signatures of today's unmanned underwater vehicles (UUVs), however, has required a paradigm shift for the Warfare Center. These smaller signatures can appear as noise in the data when measured on traditional ranges at traditional distances. Without a rapid course adjustment, the ability to measure the signatures of these smaller vehicles, and ultimately determine the operational risk to these platforms, would not be possible, raising a serious concern for the Navy.

"One of our most significant challenges was positional accuracy," Cullis said. "It's easy to see a 300-foot ship transit through a signature measurement range, but the measurement of a 3-foot UUV is significantly harder. The whole data-collection operation needed to be scaled down."

Starting from scratch wasn't an option, Cullis explained. The furious pace that UUVs are developing means the Navy, and the EOD community in particular, require answers on signatures quickly.

"If we took five years to develop a system, we'd be five years behind," Cullis said. "Instead we narrowed our focus to what could be accomplished with trusted equipment and made a portable system that can be used all over the world."

Developing a field-deployable system required overcoming technical, process and procurement challenges.

"The key is to start small, to anchor yourself, so you know when you're wrong," Cullis said. "There could be 20 answers, but if only one is right, going through a systematic process can eliminate 18."

Cullis isn't saying starting small means lowering expectations. With 32 years of experience, Cullis has learned that establishing clear objectives, requirements and logistics improve the chances of success. Likewise, he said working closely with sponsors and stakeholders to establish objectives ensures everyone involved is part of the same shared mission.

"When you discover you have the wrong answer, you improve, evolve, progress," Cullis said. "Knowing when you're right is a process; this process is how I define technical excellence."

Cullis' extensive career ranges from small-item signatures, to big ships and now tiny UUVs. He has benefited from his variety of experiences and from teammates with their own areas of expertise.

"When looking for help, identifying someone with strengths to complement your team is key," Cullis said. "You wouldn't assign a ballerina to be a carpenter; their skill sets are not suited to the task."

What drives Cullis to find the right answers is knowing the Sailors trust the engineering capabilities of everyone at Carderock: everything from signatures, controls and hydrodynamics to logistics.

"We allow them to turn the key and go," Cullis said.

Doing everything for Cullis means understanding everything from how signatures data are collected to how susceptibility is analyzed, from training manuals to how they use assets in the fleet.

"I've been in the pouring rain just to understand how things are actually done," Cullis said.

Susceptibility is about the likelihood of something being influenced by a particular thing. For Carderock's Organic Signatures Monitoring and Surface Ships Programs Branch, this could entail minimizing impacts from a UUV causing a mine to explode. When it comes to technical excellence, Cullis has maximized his susceptibility for success. To win the Department of Defense Small Program Outstanding Tester Award was no small feat. It took focus, experience, determination and above all, rigorous pursuit of the right answer that serves the mission.

Kurt Junghans wins Dr. Delores Etter Top Engineer Award

By Brooke Marquardt, NSWCCD Public Affairs

During a ceremony at the Pentagon in late June, Kurt Junghans was presented with the Assistant Secretary of the Navy's Dr. Delores M. Etter Individual Engineer Award for 2018. Junghans is a mechanical engineer in the Hydrodynamics and Maneuvering Simulation Branch at Naval Surface Warfare Center, Carderock Division in West Bethesda, Maryland.

He graduated from Virginia Tech in 1983 with a bachelor's degree in mechanical engineering and is the primary developer and advocate of the Submarine Maneuvering and Control Simulation (MCSIM).

"Finishing high school, I really had no idea what I wanted to pursue. I had an interest and aptitude in taking things apart to understand how they work, so I figured why not give mechanical engineering a shot," Junghans said. "One of my engineering courses at Virginia Tech spent a couple of weeks on simulation and modeling, and right away I knew that this was something that really interested me. When I mentioned this during my interview at Carderock, the head of the Ship Dynamics Division at the time said, 'I know exactly where I am going to place you.' That same day, I had an offer to work in the Ship Simulation Branch, and I have never looked back."

The work he does is a combination of computer engineering, fluid dynamics, physics and naval architecture. He is responsible for the development of submarine maneuvering simulations used in ship design, crew training and the development of fleet operational guidance. A typical day takes him through analyzing model tests and full-scale trials data; making simulation improvements; conducting simulation validation; supporting Naval Sea Systems Command (NAVSEA) with time-critical fleet issues; supporting various sponsors on submarine maneuvering questions; and supporting shipyards with new design concepts.

Carderock Engineer Kurt Junghans (center) receives the Assistant Secretary of the Navy's Dr. Delores M. Etter Individual Engineer Award for 2018 during a ceremony at the Pentagon on June 28, 2019. With Junhangs is Dr. Delores Etter (right) and Allison Stiller, principal civilian deputy assistant secretary of the Navy for research, development and acquisition. (U.S. Navy photo provided)

Junghans is the primary developer and advocate of the Submarine Maneuvering and Control Simulation, which is a physics-based computer simulation that models the hydrodynamics, propulsion, hydraulic actuators, variable-mass systems and automatic-control systems of a submarine. What it does is provide an accurate and rapid prediction of a submarine's maneuvering performance. Some of the simulations include: crew training on all submarine ship-control trainers, design agent support in new ship designs, automatic control system development, and fleet support in operational guidance for maneuvering, recoverability and survivability. Through the drive of many dedicated people at Carderock, MCSIM is recognized as the best submarine maneuvering simulation in the Navy and the world.

The modeling techniques in MCSIM are not necessarily new; what is new is how these modeling techniques have successfully been applied to submarine maneuvering.

"Everything in the MCSIM hydrodynamic modeling is textbook theory. MCSIM makes use of classical physics, potential-flow theory, strip theory, discrete-vortex theory, lifting-line theory and boundary-layer theory," Junghans said. "In my opinion, the secret to the simulations success is the gold mine of data we have available at Carderock. With the world-class test facilities and top-notch test engineers we have at Carderock, simulation developers have an extensive model and full-scale maneuvering data base available at their fingertips. This data is crucial in the successful development and validation of a maneuvering simulation at the confidence level required to support our Navy submarine fleet."

Junghans said one of the challenges in MCSIM development is maintaining a balance between accuracy – by incorporating relevant physics – and speed – for real-time crew training and rapid-concept design studies. The simulation is in a continuous state of advancement, making use of ever-increasing computer hardware speeds and implementing higher-order physics to assure increased accuracy while maintaining real-time performance.

Because of its speed and accuracy, MCSIM allows the submarine designer to make rapid evaluations of maneuvering impacts related to changes in the hull and appendage geometries. The designer can consider tradeoffs in maneuvering performance between various hull sizes and shapes, appendage sizes and locations, propulsion systems and main ballast-tank systems. These tradeoffs are critical when considering safe-ship operations and recoverability in ship design.

Since MCSIM runs real time and is validated in real time against an extensive set of model test and full-scale trials data, it can be used confidently for crew training in the fleet ship-control operator trainers. The crew training can encompass a wide range of operational scenarios from normal operations both surfaced and submerged, to recovering the ship from a casualty situation.

"One thing I love about Carderock is that the workday is never dull and always challenging," Junghans said. "There has not been a single day in my 36 years that I have woken up and thought that I would rather be doing something else. Rare is the day that you actually end up accomplishing what you set out to do, and rarer is the day that you can focus on one task."

Dr. Anne Fullerton receives Dr. Delores Etter Top Scientist Award

By Brooke Marquardt, NSWCCD Public Affairs

Dr. Anne Fullerton's vast experience in naval architecture, hydrodynamics and signatures has not only influenced the design of the U.S. Navy's future fleet, but also has earned her the Dr. Delores M. Etter Top Scientist Award.

As a senior research hydrodynamicist at Naval Surface Warfare Center, Carderock Division, Fullerton was recognized in a ceremony at the Pentagon on June 28 for advancing stealth technology within the Navy.

In her position as the head of Carderock's Emergent Technology Branch, Fullerton oversees the technical aspects of work efforts related to emergent infrared, electro-optic, radar cross section and radio frequency signature and supporting technologies for ships, submarines and small craft. Fullerton is the lead hydrodynamicist in her division and frequently provides consultations to other activities of the Naval Research and Development Establishment.

Fullerton earned her Bachelor of Science in naval architecture and marine engineering in 1999 from the Webb Institute in Glen Cove, New York. Webb provides a full-tuition scholarship to all those who are accepted and attend.

"I thought I wanted to be an engineer when I was in high school, but I wasn't sure what kind of engineer. When I got a flyer in the mail from Webb Institute, I did not understand that it was a comprehensive engineering program and threw it away. My dad actually fished it

Dr. Anne Fullerton, head of Carderock's Emergent Technology Branch and a senior research hydrodynamicist, receives the Assistant Secretary of the Navy's Dr. Delores M. Etter Top Scientist Award for 2018 during a ceremony at the Pentagon on June 28, 2019. With Fullerton is Dr. Delores Etter (right) and Allison Stiller, principal civilian deputy assistant secretary of the Navy for research, development and acquisition. (U.S. Navy photo provided)

out of the trash. He had been in the Army with a Webb graduate and understood that it was a great program. He's the one who convinced me to visit the school," Fullerton said.

Fullerton began a Master of Engineering program in ocean engineering at Stevens Institute of Technology in Hoboken, New Jersey, immediately following her time at Webb. During her first year of graduate school, she received a fellowship funded by the Department of Defense to pursue her doctorate (the National Defense Science and Engineering Graduate Fellowship). She successfully defended her thesis in December 2004.

Fullerton started at Carderock Division in January 2005. For her first 11 years at Carderock, Fullerton was assigned to the Naval Architecture and Engineering Department, performing experiments in the model basin and in the field, as well as processing and analyzing data, before moving to the Ship Signatures Department in 2016.

During her time in the Naval Architecture and Engineering Department, she conducted research using experimental and computational fluid dynamics (CFD) to reveal interactions between the ocean flow field and ship forms that lead to the undesirable generation of spray and droplets. These droplets can make the ships more visible and introduce significant hazards to personnel and equipment on the decks. Fullerton was also instrumental in defining the capabilities of wind-wave interaction models for the Navy's next-generation ship hydrodynamic design tool.

Additionally, Fullerton performed experiments intended to reveal the complex phenomena of how breaking waves produce impact forces on hulls. She and her team used unique instrumentation systems, which included acoustic sensors, laser-sheets, pressure sensors and scanning light detection and ranging systems, to investigate the flow around the ship hulls and the resultant impact forces to support CFD validation studies.

Fullerton also designed a system that used an array of ultrasonic sensors and a phased-array post-processing algorithm to measure the directional spreading of wave energy that is now used by multiple Navy teams.

"Each individual sensor will give you a time-dependent measurement of wave height. If you have multiple sensors and know how far apart they are, you can determine the phase differences between the measurement points, which then describes the directional wave field," Fullerton said.

In the Ship Signatures Department, Fullerton said she is able to leverage her broad spectrum of experience to help solve multidisciplinary technical issues the Navy is facing.

"The unique perspective that I bring to my work derives from my collection of experimental experiences in naval architecture, physical oceanography, ocean dynamics; and the marine atmospheric environment; an understanding of computational predictions; and a continued education in signatures," Fullerton said.
Fullerton said she greatly appreciates the opportunities she has had to collaborate with her hard-working and technically experienced colleagues.

"In my time at Carderock, I've found that a person's technical background doesn't matter as much as their ability to think critically and their desire to learn about new things," Fullerton said. "Every achievement has been a direct result of the efforts of an extraordinary team. I am thankful every day for the great group of people that I work with."

When asked how often she fails, she answered, "I am usually more at the research end of things, in the beginning stages of application. We fail all the time, but we don't stop until we find success. We're thoughtful about how we approach problems and use scientific methods and engineering principles. But we're on the edge, and we don't usually get it right on the first try, so we have to try something else. Said differently, every success is at the end of multiple failures. This type of work can be frustrating and requires time, patience and persistence," Fullerton said. "And when it finally works, it is hugely rewarding."

Fullerton also received The 2018 Rear Adm. David W. Taylor Award, one of eight Carderock Division Honor Awards, for her crucial role in the formulation, validation and application of theoretical models and computer- and physical-model simulations of electromagnetic signatures. The Taylor award recognizes outstanding scientific contributions developing future maritime systems through the creation of technology-based research. Rear Adm. David Taylor is considered Carderock's founding father.

"Through the work with my team and the support of leadership, as well as the various experiences I had, I was able to bring a new capability to Carderock," Fullerton said. "The capability that we stood up here, in the long term, will provide and enhance warfighting capability."

NAVSEA Warfare Centers' commander visits Carderock

Evan Handler (center), an engineer at Naval Surface Warfare Center, Carderock Division, tells Rear Adm. Eric Ver Hage, commander, Naval Sea Systems Command (NAVSEA) Warfare Centers, and Capt. Cedric McNeal (left), Carderock's commanding officer, about Carderock's additive manufacturing program during Ver Hage's visit to the West Bethesda, Md., headquarters for a command brief and facilities tour. (U.S. Navy photo by Nicholas Brezzell/Released)

Happenings
at Carderock

Goggins visits Carderock's detachment in Memphis

By Katie Ellis-Warfield,
NSWCCD Corporate Communications

Rear Adm. David Goggins, Mike McClatchey and Capt. Cedric McNeal visited the William B. Morgan Large Cavitation Channel (LCC) in Memphis, Tennessee, on July 23, 2019. Goggins is the Program Executive Officer for Submarines; McClatchey a member of the senior executive service is the director for Advanced Undersea Integration at Naval Sea Systems Command (NAVSEA); and McNeal is the commanding officer of Naval Surface Warfare Center, Carderock Division. The LCC is a detachment of Carderock's Division.

Commissioned in 1991, the LCC is one of the world's largest and most technically advanced high-speed, variable-pressure water-tunnel facilities. Originally used to evaluate cavitation erosion on surface ships, the LCC for the last 10 years has been home to advancing the design of submarine propulsors.

"I think it's important for our sponsors and key stakeholders to get eyes on target for the work that's going on across the division which also includes our remote sites, such as the LCC Memphis," McNeal said. "The work they do is not only first-class, but also critical to ensuring performance characteristics are fully understood in the design of our platforms that will take us well into the future."

The LCC is capable of testing all types of ship and submarine propellers and propeller-hull interactions. While touring the facility, Goggins was able to see next-generation submarine designs using a Very Large Test Apparatus (VLTA) being tested inside the channel.

Carderock's Naval Architecture and Engineering Department head Mike Brown said that Goggins was able to get an appreciation during this visit of the strategic importance of keeping a facility like this operating to support future advancements in propulsor design.

"We wanted Goggins to understand the complexity of the testing and the scale of the VLTA model and the LCC facility,"

Brown said. “He was excited at the possibility to demonstrate rapid prototyping of submarine shapes and other features using large-scale 3D printing capabilities at the facility.”

“Besides being a facility to investigate performance of submarine propulsors, there is an opportunity in the future to bring in full-size or near full-size unmanned underwater vehicles to test hydrodynamic performance characteristics,” Brown said.

Presentations and discussions during Goggins visit not only covered VLTA testing for the USS Virginia and Columbia-class submarine programs, but also the LCC sustainment and the potential next test facilities located at the LCC.

“It’s important for our stakeholders to understand our needs in the sustainment of our facilities; specifically what it takes for our team to be ready to deliver in supporting customer needs,” McNeal said. “It’s more than just can we support a specific event at a specific point in time, but it’s also the maintenance and upkeep to ensure our investments in machinery and equipment remain viable in supporting future demands.”

LCC Site Director Matt Brantz said that the meetings regarding the LCC’s future work were very productive and highlighted the importance of the LCC as a strategic asset for the Navy.

“Goggins got to see firsthand that the LCC is a strategic asset for the Navy and it plays a crucial role in the development of submarine propulsion systems,” Brantz said.

“As the Navy continues to design ships and submarines in preparations for tomorrow’s fleet, it remains critically important for us to ensure technical risk areas for design and performance to requirements are mitigated using facilities such as the LCC in fielding next-generation capabilities,” McNeal said

Program Executive Officer for Submarines Rear Adm. David Goggins (second from left) discusses the Large Cavitation Channel (LCC) with Commanding Officer Capt. Cedric McNeal; Site Director Matthew Brantz; and Naval Architecture and Engineering Department Head Mike Brown during a tour of the facility in Memphis, Tenn., on July 23, 2019. The LCC is a detachment of Naval Surface Warfare Center, Carderock Division. (U.S. Navy photo by Katie Ellis-Warfield/Released)

Former SECNAV Winter talks acquisition at Carderock

By Kelley Stirling, NSWCCD Public Affairs

Acquisition was again the subject at the Rear Adm. David Taylor Naval Architecture Lecture on May 16, and this time, the lesson came from someone who has been at the top.

Dr. Donald Winter, secretary of the Navy from 2006 to 2009, spoke about his experience in contracting throughout his career, including when he was the secretary.

Winter provided a few postulates about acquisition to prepare the audience for discussion: acquisition is not just procurement; acquisition of complex systems is difficult; acquisition of naval vessels is even more difficult; systems engineering is the key to making acquisition work; and getting acquisition right is important. He also posed three basic questions when thinking about providing a new asset to the fleet.

"You have to decide what it is you want to buy; you have to decide how you want to buy it; and then, and only then, can you get to the question of who you are going to buy it from," Winter said.

Part of the complexity stems from having multiple stakeholders with differing priorities and agendas, which can result in conflicting objectives. These stakeholders include Navy leadership, Navy operators, Congress, the Office of Management and Budget and industry.

In addition, Winter said that real-world problems are often poorly defined. Stakeholders have a hard time translating their objectives into engineering terms.

"Some people want to have a ship that's really inexpensive; some people want to have a ship that's really fast; some people want to have a ship that has got great survivability," Winter said. "And those are not necessarily well-aligned objectives."

Dr. Donald Winter, secretary of the Navy from 2006 to 2009, speaks about naval acquisition at the Rear Adm. David Taylor Naval Architecture Lecture on May 16, 2019, at Naval Surface Warfare Center, Carderock Division in West Bethesda, Md. (U.S. Navy photo by Monica McCoy/Released)

Winter said using the principles of systems engineering is the best way to reconcile the inconsistencies between objectives.

"Systems engineering is a methodology to convert objectives to requirements that can provide direction to the design teams," Winter said.

As part of the systems engineering process, Winter said the stakeholders and their objectives are identified and various alternative system concepts are developed in an attempt to reconcile conflicts among stakeholders and address the priority objectives. This requires an understanding of where trades are possible. Once a preferred concept is chosen, a system specification can be developed documenting the top-level system requirements.

Identifying a suitable system concept generally requires looking into the future at what the mission might be.

"In particular, one of the problems I've seen is that it's very difficult to forecast what we really need from a mission point of view, because of the tremendous lag between the conceptual work that's done and the actual employment of those assets as part of some naval group in the future," Winter said.

When it comes to actually figuring out how to acquire something, Winter said people often fail to think through the options that are available. He used the U.S. Navy's development of the Electromagnetic Aircraft Launch System (EMALS), which replaced the steam-driven catapults on Ford-class carriers (CVN 21), and the Advanced Arresting Gear (AAG), which replaced the hydraulic system. There were two reasons Winter thought this program has been compounded with difficulties: EMALS and AAG were developed concurrently with CVN 21; and they were procured by the Navy and provided to the shipbuilder as government-furnished equipment.

"Concurrent development is a disaster. If you take a look at the technology readiness level associated with EMALS at the time that decision was made, there was no way that it should have been approved for concurrent development," Winter said. "We are still trying to figure out the operational suitability of this whole configuration."

When selecting a contractor, Winter said there are two basic options: lowest price, technically acceptable; and best-value determination. Except for the simplest vessels, the process tends to be best-value determination. He said that the challenge is determining what constitutes best value for the Navy. Best value is typically defined as the highest performance at the lowest cost. Unfortunately, this view motivates bidders to eliminate all performance margins and include the plans and costing for only the essential activities, without any reserves. The resultant program plan is inexecutable as it provides no mechanism to deal with the inevitable developmental problems.

"I've yet to see a program that's gone through as planned," Winter said. "I find LCS (littoral combat ship) to be particularly illustrative of this problem."

Winter said that about 20 years ago, the Navy set objectives for small surface combatants to address the emerging "green water" threats, such as the Iranian Revolutionary Guard Corps Navy. They wanted it to be 40-plus knots with reduced manning, all for $220 million, and they wanted 55 of them. The contractors naturally said they could do it, but the designs compromised reliability and sustainability.

"I keep wondering what would have happened if we had been honest and said the cost was going to be $550 million, which is about where it's at now," Winter said.

Winter said systems engineering also needs to continue post award of the contract and throughout the development process.

"The most important aspect is that the lives of the future Sailors in our Navy are at risk, and they are depending on us to do this right," Winter said.

Former technical director Fein discusses Carderock's innovative history

By Benjamin McKnight III, NSWCCD Public Affairs

For much of its existence, Naval Surface Warfare Center, Carderock Division has been at the forefront of naval innovation. James Fein, a former technical director at Carderock, witnessed some of the transformative years of the command's contributions to the Navy, coming onboard in 1969.

July's Rear Adm. David Taylor Naval Architecture Lecture featured a trip down memory lane with Fein as he delved into a handful of technological and theoretical advancements that came from Carderock through the years. Well before his arrival, advancements were occurring from ideas produced by employees of the command, some of whom Fein had the opportunity to work with before beginning to add his own major contributions.

"Carderock was really the intellectual heart of naval architecture and hydrodynamics in the late 1940s and early 50s," Fein said. "Then, in the late 60s and early 70s when I got here, there was a big explosion, because Adm. Elmo Zumwalt was the CNO and wanted a 100-knot Navy."

Fein separated three key categories of breakthroughs: advances in naval theoretical science; new hull forms that transitioned to the fleet; and innovative design tools and approaches. Much of the lecture focused on the new hull forms and the improved ship concepts coming from the earlier era, although Fein himself was more involved with the innovative design tools and approaches beginning in the 1980s as computational work saw a heavy increase in use.

The sources of Carderock's innovation boom came from a multitude of people with varying backgrounds. For instance, Karl Schoenherr, one of those trailblazing employees listed by Fein, was a German soldier in World War I who escaped capture and immigrated to Canada. He eventually earned a degree from the Massachusetts Institute of Technology and began his Naval Sea Systems Command career working at the experimental model basin at the Washington Navy Yard in 1921. He also highlighted the works of Elizabeth Cuthill and Joanna Schot, women he said were pioneers in much of the computational work done today for structural and hydrodynamic calculations.

All experimental processes include trial and error, a cycle with which Carderock is familiar. One of the first innovative ship concepts discussed by Fein were hydrofoils, a type of boat that lifts its hull out of the water to increase speed.

"In the late 40s, we had a Navy experimental hydrofoil and then in the 60s going into the 70s, we had four different classes of hydrofoils built for the Navy," he said.

However, maintaining the hydrofoils proved to be costly for the Navy, and they were phased out, first by reassigning them to the Coast Guard before the military completely abandoned the concept.

"You can still do hydrofoils today, but it is not something that we're looking to be doing in the future," Fein said.

Another major vessel invention of the 1970s that Fein talked about was the surface-effect ship (SES), created by Al Ford. Before joining Carderock in 1965, Ford was at Naval Air Systems Command in Philadelphia where his work on inventing the SES began. From this came two models of the ship, the 100A and 100B, with the first of the two getting extensive testing at Carderock. While the original designs came from elsewhere, the results from its testing at Carderock lead to a handful of improvements to the 100A.

"It had a totally different bow when it came to us that was supposed to have something like a captured air bubble in the bow to keep it from leaking air around the bow seal," Fein said. They also improved the water-jet system that came on the vessel, leading to increase sailing speeds. Other Carderock-influenced ship concepts Fein discussed were air-cushion vehicles, hydrofoil small-waterplane area ships, small-waterplane twin hulls, trimarans and Glomar explorers.

Navy-wide innovation impacts can still be linked to Carderock in the 21st century, such as the Zumwalt-class destroyers. In January of this year, the Navy commissioned the USS Michael Monsoor, the second of three planned Zumwalt vessels. The USS Zumwalt was the first of the trio to hit the sea 2016; the USS Lyndon B. Johnson will follow in 2022.

Keeping Carderock involved with the naval advancements requires interacting and exchanging ideas within industry, academia and foreign entities, according to Fein. Most important, though, he said the command must continue to hire and retain the best people for the jobs.

A model of the SES 100A prepares for testing. The SES 100A was one of many naval architectural advancements discussed by James Fein during July's Rear Adm. David Taylor Naval Architecture Lecture that were influenced by employees of Naval Surface Warfare Center, Carderock Division. (Photo provided by James Fein)

Happenings
at Carderock

Nationally syndicated CW Network films at Carderock

A CW Network camera crew interviews Capt. Cedric McNeal, commanding officer of Naval Surface Warfare Center, Carderock Division, on June 3 about the important research work Carderock does for the Navy. The CW Network was on base to gather interviews and video to inform a new series they are doing called Mysteries Decoded, specifically about the disappearance of USS Cyclops (AC 4) in March 1918 from the area of the Bermuda Triangle. The episode aired Sept. 17, 2019. (U.S. Navy photo by Monica McCoy/Released)

Happenings
at Carderock

Inclusion, a focus of second annual Leadership in a Diverse Environment Event

By NSWCCD Pubic Affairs

Kathy Stanley, chief of staff for Naval Surface Warfare Center, Carderock Division, gives an overview of the Leadership in a Diverse Environment event held May 16, 2019, at Carderock's West Bethesda, Md., headquarters. This still is taken from video on Carderock's YouTube channel: https://www.youtube.com/watch?v=WlErHb6JSac&t=13s (U.S. Navy video by Nicholas Brezzel/Released)

Naval Surface Warfare Center, Carderock Division held a Leadership in a Diverse Environment event May 15-16 with the theme "One Navy: Inclusion for Success." This is the second annual LDE event held by Carderock.

Technical Director Larry Tarasek in his opening remarks talked about progress the command has made on diversity and inclusion in the 30-plus years he has worked at Carderock, saying the command has had successes, but must keep focusing. He also emphasized that with the Great Power Competition, Carderock and the Navy must keep ahead of technical challenges in order to dominate the United States' competition. In order to help solve problems, Tarasek said the command needs diversity, including diversity of thought.

"As we bring that diversity of thought, we need to make sure folks feel included. They have to feel a part of our team," Tarasek said.

Speakers for the event included Lt. Gen. Gwen Bingham, the U.S. Army's assistant chief of staff of installation management; Ashley Merryman, the chief of naval operation's advisor on diversity and inclusion; Dr. Steve Robbins, best-selling author and speaker on diversity; and Dr. Stephanie Credle, director of Naval Sea Systems Command's Equal Employment Opportunity office. The event also had several lectures and panel discussions.

"We need to make sure that we're expressing words of affirmation and expressing words of inspiration to the next generation," said Capt. Cedric McNeal, Carderock's commanding officer, describing why he thinks it's important to host events like this for the workforce. "To that new kid or person that shows up to our organization, let's be the first person to reach out to them and make them feel at home."

"I challenge you to take steps to embrace the notion of diversity; take steps to get out of your comfort zone and be a champion for inclusion," McNeal said in his closing remarks. "Your initiative has potential to make a world of difference in a person or contingent of people that can be more productive or more effective members within our organization. We are one team, we are one family, and we are all after one fight as the Navy."

See a video highlight of the LDE event on Carderock's You Tube channel: https://www.youtube.com/watch?v=WlErHb6JSac&t=13s

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Bingham: Inclusion improves military strength, readiness

By Benjamin McKnight III, NSWCCD Public Affairs

The 2019 iteration of Leadership in a Diverse Environment at Naval Surface Warfare Center, Carderock Division, featured a handful of big names on the list of guest speakers to discuss all things related to leading diverse workspaces.

Kicking off the two-day event May 15-16 was Army Lt. Gen. Gwen Bingham, the assistant chief of staff for installation management. The Troy, Alabama, native spoke about the importance of being a role model to future generations of leaders through fairness and inclusion. Her remarks were equally anecdotal and philosophical, drawing from experiences between her time at the University of Alabama and her 36-year career throughout her message.

As a college student looking to bolster her GPA, Bingham took a sociology class that she assumed would be an easy A. After failing the first of two exams for the course, she went to her professor's office to discuss ways she could improve in the class, only to be told by her professor, "It's a known fact that people like you don't do well in education."

"I found myself with tears welling up in my eyes, but stood up and thanked him for his time," Bingham said.

That conversation stayed with Bingham for most of her career, but not in the form of a crutch. She said that she would go on to fail the class, which was not the professor's fault, although, "He certainly didn't encourage me by any stretch of the imagination." From that conversation forward, she vowed to treat everyone she encountered with dignity and respect.

When she was an Army captain, a senior leader told her that she had very little chance to be considered for battalion command because her experience was lacking. Faced with yet another obstacle in the way of her progression, Bingham assured her superior that she would give her best effort to her duties every day. Since that conversation, she has assumed numerous commands en route to becoming a three-star general and held on to a valuable lesson in the process.

"I learned that I would not play God with somebody else's life," she said. "I believe if you can conceive it, and you believe it, with hard work and perseverance, you can achieve anything."

Bingham's ability to navigate through the various instances of adversity in her career helped form her current philosophy on leadership with an emphasis on stressing inclusion to bring the best out of her teams.

"I certainly found that our units are better as a result of this surge of inclusion and diversity that's going on," she said. "Inclusion makes our military stronger and more ready."

Part of Bingham's remarks included asking the audience during her presentation to list character traits they believed make up a good leader. With words such as ethical, organized, empathetic, inspiring and many more listed, she said that it is equally important that leaders and non-leaders alike apply as many of those attributes to their daily lives, as the non-leaders might one day find themselves in charge of others.

Near the end of her discussion, Bingham offered a brief question-and-answer session during which she delved into other aspects of her career experiences, like balancing family life with her decorated Army career. At the root of her message, she emphasized that nothing for an organization is possible without operating as a team. Doing so requires all parties involved to be capable of respecting each others' experiences and including people not like themselves.

"That's what makes our nation stronger," Bingham said. "The diversity we have inside our ranks, what everyone as individuals brings to the table and the spirit of being included in something that's bigger than ourselves."

Leadership in a Diverse Environment: Dr. Steve Robbins

By Edvin Hernandez, NSWCCD Public Affairs

Dr. Steve Robbins, an author and guest speaker at Naval Surface Warfare Center, Carderock Division's Leadership in a Diverse Environment II event, analyzed the behavioral science and neurological approach to understanding biases during a humorous, yet serious lecture on May 16. Robbins explained that a bias is a patterned behavior and cognitive shortcut that the brain takes to preserve energy. Before deeming a bias good or bad, it must first be attached to a goal.

"If your bias helps you achieve your goal, that's a good bias, but if the bias prevents you from achieving your goal, then it's a bad bias," Robbins said. A bias in itself is fundamentally neutral, he explained, confirming that biases develop a negative reputation when improperly discussed. "When you study the brain, you learn that biases are neutral things and that's how different perspectives approach different subjects when it comes to inclusion and diversity."

From a neuroscience perspective, Robbins highlighted that people tend to associate with others who are like them because it is easier.

"We like to hang out with people from our own tribe who have similar beliefs and similar attitudes," he said. "So from a neuroscience point of view, we exclude people not because we necessarily hate them, but because we just don't know that much about them. We stick with people who are like us."

Robbins said humans actively use their "modern" and "ancient" brains. The "modern" brain participates in metacognition, which allows a person to analyze and reflect on his or her own thoughts. On the other hand, the "ancient brain" is not designed to analyze thoughts and, instead, reacts without thinking using developed heuristics.

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Dr. Steve Robbins, an author and inspirational speaker, addresses the audience of Naval Surface Warfare Center, Carderock Division's Leadership in a Diverse Environment Event on May 16, 2019, about natural biases and how to think through them and be inclusive. (U.S. Navy photo by Kelley Stirling/Released)

People learn individual biases through their environments, where the repetition of inaccurate generalizations are engrained into their way of thinking. Robbins used the example of learning the lyrics to a new song to explain this process.

"When the words to a new song get stuck into your head, it happens without you knowing from the music playing in the background, and your brain picks up the words for you," he said.

Similarly, after learning this behavior, a person's "ancient brain" will automatically trigger and assign close-minded stereotypes, even if it is involuntary.

"We don't have to give our brains permission to create mental models and stereotypes," Robbins said. "We use mental models to judge and evaluate things that we encounter. When you use your ancient brain to do that, your ancient brain doesn't assess the information before it uses it; it just uses the stereotype-based information."

Robbins believes diversity is not the problem and, in fact, shared that close-minded mentality inevitably leads to exclusion.

"For me, diversity is having more than one person in the room; we all bring diversity," he said. "However, diversity and close-minded thinking leads to misunderstanding, miscommunication and conflict, but imagine having diversity and open-minded thinking. Now there is greater opportunity and possibility for inclusion."

Robbins examined the way that some individuals perceive people with tattoos, for example, as an indication of the person with tattoos making poor life decisions.

"How many times have we heard, 'People with tattoos make stupid decisions, probably did not do well in school, use drugs, ride motorcycles and beat people up,' or messages similar to those with negatives connotations," he asked.

In reality, however, the only thing anyone knows about people that have a tattoo is that they have a tattoo.

This "noise" produces a cognitive distraction and blurs reality. It can hide talent from people who are interviewing for a position, for instance. Likewise, an accent can also hide a lack of talent from unqualified candidates.

Exclusion then, naturally casts a division between insiders and outsiders. When someone makes a mistake, but pertains to an environment with similar beliefs, then the mistake is easily forgiven or excused. However, the same is not true about someone who shares no similarities with the judging group.

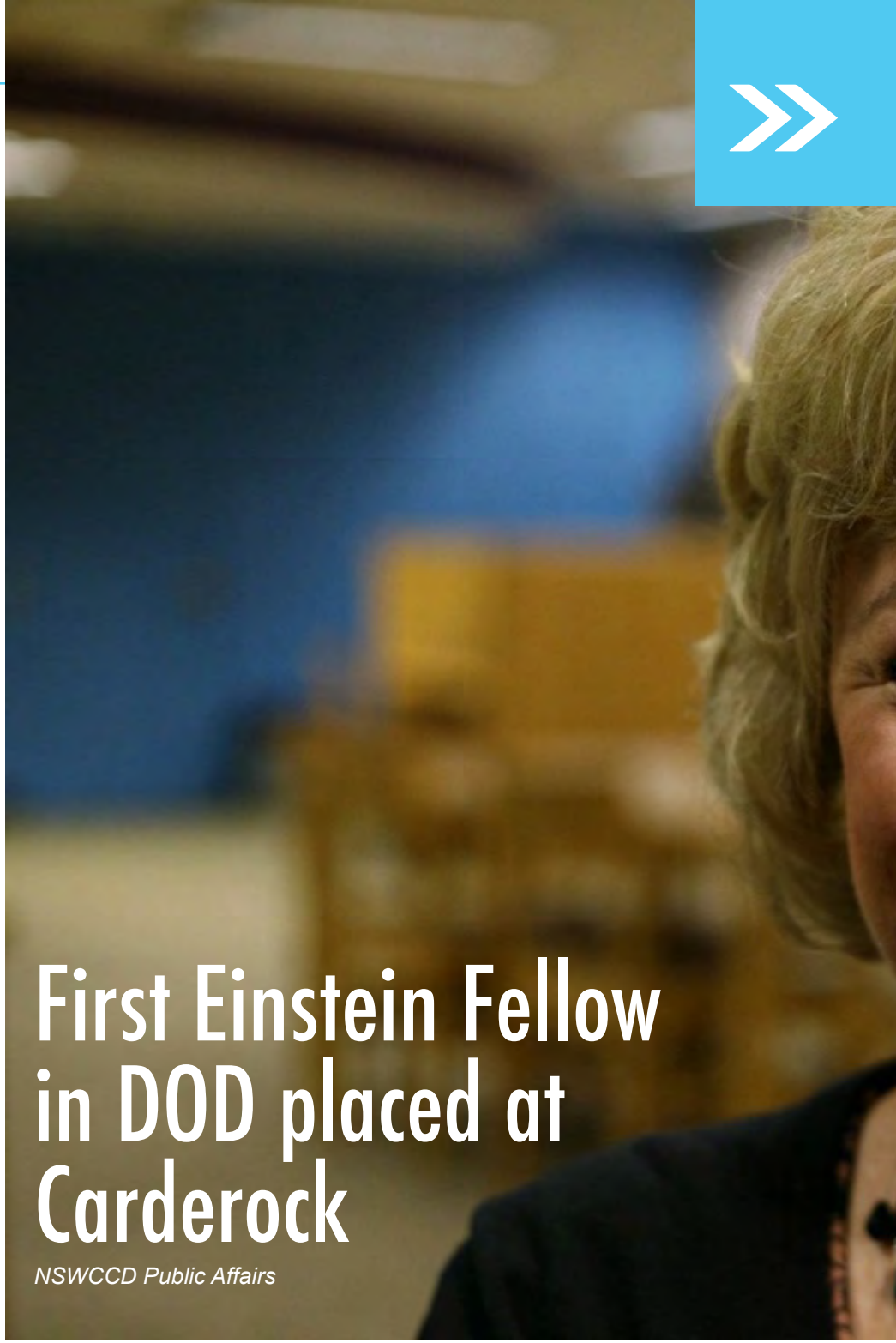
"Humans look for indicators that determine if an outsider is part of their tribe or not, and they do this for safety," he said.

According to Robbins, individuals want to feel safe, and diversity is effective when people are all insiders. Expectations of experiencing fairness, belonging and authenticity contribute to feeling like an insider and promote inclusion.

Robbins challenged the audience to keep an open mind and remember that everyone walks a different path. He encouraged taking a pause and finding ways to make employees feel welcomed in the workspace.

"The same way an athlete needs to be ready to take the field on game day, we as employees need to be mentally concentrated and comfortable in our workplace to perform our best," he said.

Robbins chose his career path to honor his mother and sister as an immigrant from Vietnam after experiencing a childhood of poverty, discrimination and trauma. His approach to diversity and inclusion uses neuroscience and the science of human behavior to encourage individuals and organizations to value people for their unique gifts, abilities and experiences.



First Einstein Fellow in DOD placed at Carderock

NSWCCD Public Affairs

Debbie Reynolds, a science, technology, engineering and math (STEM) educator in the Baldwin-Whitehall School District of Pittsburgh, has been selected to come to Naval Surface Warfare Center, Carderock Division, as part of the Albert Einstein Distinguished Educator Fellowship (AEF) Program.

One of nine Einstein fellows selected from across the country for the 2019-2020 AEF Program, Reynolds is not only the first to be placed at Carderock, but also the first for the Department of Defense (DOD). She started her 11-month fellowship in September. She will serve at Carderock for 11 months starting in September 2019.

"I am so grateful, humbled and excited for the opportunity to serve as the first Fellow at Carderock," Reynolds said. "I have such a passion for STEM education and have tried to share that passion with students and colleagues throughout my career."

The U.S. Department of Energy (DOE) Office of Science's Office of Workforce Development for Teachers and Scientists manages the AEF Program, now in its 29th year of operation. It provides a unique opportunity for accomplished K-12 STEM educators to apply their extensive classroom knowledge and experiences to their host offices to inform federal STEM education efforts.

Carderock is joining the list of current sponsoring agencies of the program, which also includes Oak Ridge Institute for Science and Education, the National Science Foundation, the Library of Congress, NASA and several U.S. congressional offices.

Carderock signed a memorandum of agreement (MOA) with DOE to participate in the AEF Program earlier this year. Signed by Technical Director Larry Tarasek, the MOA made reference to the Navy's need for a steady recruiting pool of graduates in the STEM fields, who, when hired here at Carderock, will enhance the nation's edge in the Great Power Competition.

"By having an Einstein Fellow here at Carderock, we are working toward having an even more robust STEM program than we already have, which will ultimately provide a vibrant recruiting source for our future generation of engineers and scientists," Tarasek said. "This is a win-win for us. Not only will Ms. Reynolds' wealth of knowledge help inform our future STEM and outreach program, but what she learns here will also allow her to develop that next generation workforce in her hometown of Pittsburgh."

Carderock's STEM and Outreach Program supports a broad range of educational outreach programs, with the long-term goal of building a relevant and capable future STEM workforce. It aims to strengthen the STEM workforce pipeline through outreach by inspiring student's interest in STEM through hands-on, accessible application of naval STEM fundamentals; provide practical experiences to engage students and teachers of all ages to learn by doing; and educate the next generation with foundational skills and knowledge needed to pursue advanced STEM education and careers.

"We impact thousands of students

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across the nation every year in our efforts to inspire, educate and engage learners of all ages in naval-relevant STEM subjects," said Charlotte George, director of Carderock's STEM and Outreach Program. "We are excited to work with the AEF Program to create a more sustainable, informed STEM and Outreach Program based on open-ended challenges that will promote students' ingenuity and creativity. Ms. Reynolds will bring an educator's perspective to Carderock's STEM efforts, and ultimately Department of Defense STEM efforts."

As part of the AEF Program, the Einstein Fellows gain an understanding of the role of the federal government in the U.S. education enterprise, knowledge of resources available to students and educators, and broader perspectives on national education issues that can be applied to the classroom or to leadership positions in their districts or elsewhere.

Reynolds has 25 years of experience in education. She is the STEM integration specialist at Harrison Middle School, where she works with other teachers to integrate STEM into every classroom.

"Our students and their parents are very interested in STEM education and activities," Reynolds said. "We have to pass on a love for STEM subjects to our students when they are young so they will continue to pursue STEM subjects in high school and beyond."

Jack Templeton, Carderock's chief technology officer, said Carderock is excited to embrace Reynolds' educator perspective to improve the quality of Carderock-developed material for teachers and students; to further develop a suite of naval-relevant STEM education modules for varying grade levels; to improve networking of local academic communities; and to better understand STEM education techniques and classroom culture. He hopes to see the greater DOD utilize the AEF Program further in the future.

"I know having Ms. Reynolds here is going to be a great benefit to how we advance our STEM program," Templeton said before retiring this summer as Carderock's chief technology officer. "I'm excited to see how the Einstein Fellow program will make an impact, not just here at Carderock, but because of the vibrant Warfare Center STEM outreach network, across the entire NAVSEA (Naval Sea Systems Command) community."

In other federal facilities, previous Einstein Fellows have created and implemented national STEM education programs and tools; initiated collaborations and partnerships among federal agencies; and designed and deployed digital and online national learning tools for students and teachers.

"The opportunity to bring a unique perspective as an educator and work with national DOD STEM initiatives to influence K-12 STEM education on a national level is the chance of a lifetime," Reynolds said. "I look forward to learning and working with the team and the STEM experts at Carderock throughout the next year."


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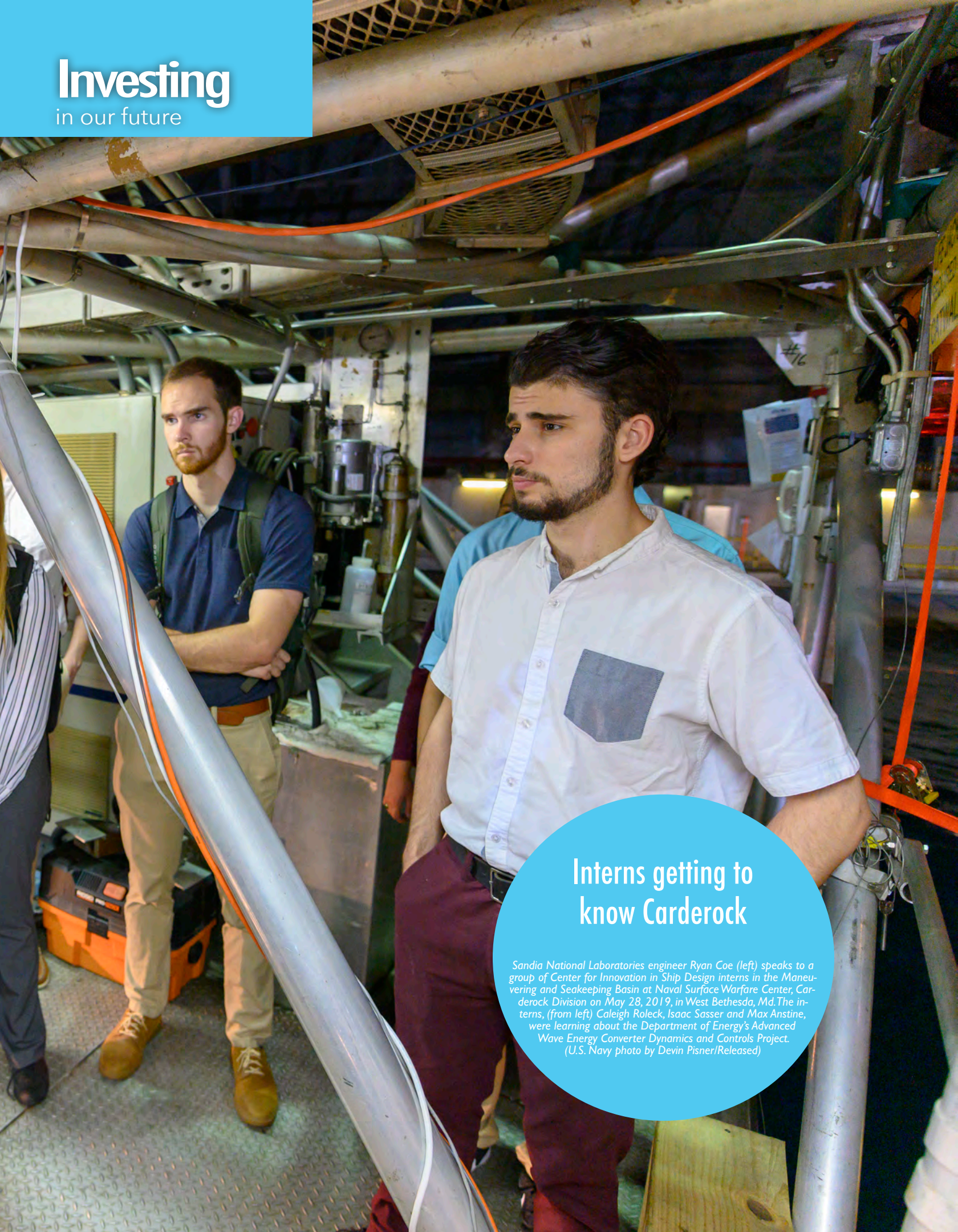

Interns getting to know Carderock

Sandia National Laboratories engineer Ryan Coe (left) speaks to a group of Center for Innovation in Ship Design interns in the Maneuvering and Seakeeping Basin at Naval Surface Warfare Center, Carderock Division on May 28, 2019, in West Bethesda, Md. The interns, (from left) Caleigh Roleck, Isaac Sasser and Max Anstine, were learning about the Department of Energy's Advanced Wave Energy Converter Dynamics and Controls Project. (U.S. Navy photo by Devin Pisner/Released)

Carderock interns visit the Washington Navy Yard

Naval Surface Warfare Center, Carderock Division interns (from left) Jacob Lamoureux, Zachary Norstrom, Caroline Hanson, Danny Tran; and Michael Ford, an engineer in the Carderock's Future Ship and Submarine Concepts Branch, stand on a World War II 40-mm Quad 40 Bofors anti-aircraft gun mount during a visit to the National Museum of the U.S. Navy in Washington, D.C., on June 4, 2019. (Photo provided)

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Carderock employees "Meet the Fleet" in Norfolk

Lt. j.g. Sebastian Welch (right) gives Naval Surface Warfare Center, Carderock Division employees and interns an overview of USS Mahan's (DDG 72) helo deck before embarking on a tour of the Arleigh Burke-class destroyer during Carderock's "Meet-the-Fleet" trip to Naval Station Norfolk on July 16, 2019. (U.S. Navy photo by Lydia Weyrich/Released)

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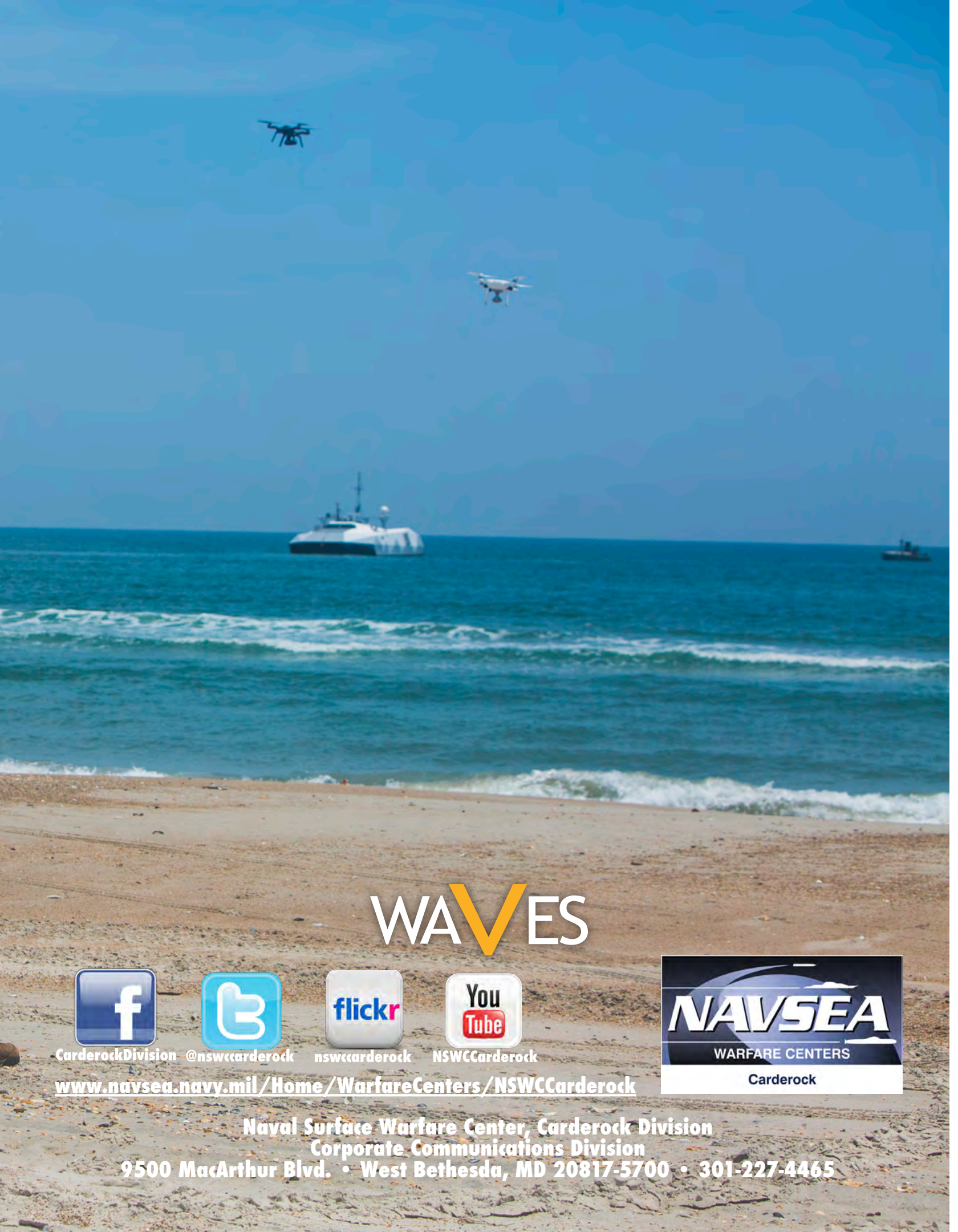
Carderock interns conceptualize new DTLe design

Working in the Disruptive Technologies Lab, high school interns (from left) Matthew Chen, Matthew Mitchell, James Muha and Daniel Gross discuss potential tool-less manufacturing ideas at Naval Surface Warfare Center, Carderock Division's sandpit, "The Beach." David Newborn (center), an ocean engineer in the Maritime Systems Hydromechanic Branch, guided the conversation with the students on July 31, 2019. (U.S. Navy photo by Edvin Hernandez/Released)



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