2019 Issue 2

WAVES

HOW HISTORY INFORMS THE FUTURE

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Content

Cover

Snapshots of USS Thresher (SSN 593) are overlaid on an artist rendering of the future Columbia-class ballistic missile submarines. Thresher sank during deep-dive testing in 1963 and changed the culture of submarine safety and future submarine development. (Photo illustration is a combination of an image from Naval History and Heritage Command of Thresher at sea in 1961: NH 97544; and a U.S. Navy illustration released in March: 190306-N-N0101-125)

In this issue

You've heard the old adage "History has a way of repeating itself." Well, in some cases, we hope not. You'll see many stories in this issue of Waves about how history informs the future. We often have speakers at Carderock that have looked at the history of shipbuilding and have made suggestions for the future of shipbuilding. We have scientists and engineers that are studying shipwrecks to make sure we know what went wrong and how we can make sure our ships are safe in any ocean environment.

When our experts take the knowledge they have, either gaining it from history or from their own research, and develop new technologies or processes, we want to make sure that knowledge gets shared with the future generations. There are a couple of articles in this edition of Waves that speaks to how some of our folks are doing that, by ensuring technical excellence in their project management; getting a patent on an improved technology; or creating a book on the research they have done.

You'll see that we had a change of command recently. While Carderock is made up primarily of civilian employees, having a Navy captain at the helm reminds us why we are doing what we are doing working for our Sailors and Marines. And the tradition of a change of command ceremony really brings it home.

I hope you enjoy this edition of Waves.

WAVES

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Carderock Division change of command

By Kelley Stirling,
NSWCCD Public Affairs

Capt. Cedric McNeal (left) reads his orders as the new commanding officer of Naval Surface Warfare Center, Carderock Division, relieving Capt. Mark Vandroff (right) in a change-of-command ceremony May 3, 2019, in the Maritime Technology Information Center at Carderock Division in West Bethesda, Md. (U.S. Navy photo by Nicholas Brezzell/Released)

Capt. Cedric J. McNeal relieved Capt. Mark R. Vandroff as the commanding officer of Naval Surface Warfare Center, Carderock Division in a ceremony May 3, 2019, in the Maritime Technology Information Center at Carderock Division in West Bethesda, Maryland.

Vandroff, who was the 37th commanding officer at Carderock, thanked the many people in his life who have contributed to his success as a naval officer, to include his family and friends, as well as employees at Carderock.

"Carderock is an amazing place, a national treasure, where science and engineering are harnessed in the service of our Navy's warfighters," Vandroff said. "It has been a privilege to be a member of this organization, and I will always be grateful for the opportunity to be part of this important work."

During his time at Carderock, Vandroff said there has been a rise in the number of people leaving Carderock, mostly through retirement. At the same time, though, Carderock has grown and hired at higher than the attrition rate to support additional technical research as necessary for the Navy. Vandroff said the new people coming in, whether engineers, scientists or business professionals, are some of the smartest and most diverse he's ever seen.

"We still have a very high-quality workforce, and we've brought on so many great, new people across the spectrum, both here and at the detachments, and across all the skills, so many great engineers, great business professionals," Vandroff said. "The ability to grow that workforce, and have it be such a talented workforce – that's probably what I'm proudest of."

Vandroff said the onboarding process of all the new employees over the last three years has become a little easier, especially with the establishment of the Common Access Card office on base, which has really improved the quality of life and quality of service for those employees.

During the ceremony, guest speaker Rear Adm. William Galinis, Program Executive Officer, Ships at Naval Sea Systems Command (NAVSEA), touted Vandroff's naval career as very successful.

"Under Mark's leadership, Carderock has continued to lead the way in naval architecture and marine engineering, pioneering the use of set-based design and building the next generation of design tools, which will lead to improved modeling and simulation capability in the ship-design process," Galinis said.

Capt. Andy Arnold, chief of staff for

Naval Surface and Undersea Warfare Centers, presented the Legion of Merit Medal to Vandroff for his performance as the commanding officer of Carderock Division, specifically citing Vandroff's role in providing significant analysis to the Surface Warfare Resource Sponsor regarding the Future Frigate, Zumwalt-class destroyer and Future Large Surface Combatant.

Retired Rear Adm. Tony Lengerich, currently the president of the American Society of Naval Engineers (ASNE), presented Vandroff the 2018 ASNE Gold Medal Award for his accomplishments as the DDG 51 program manager and for his time as commanding officer of Carderock.

Vandroff is retiring June 1 after 30 years of service, which started with his commissioning from the U.S. Naval Academy in 1989. He has taken a job as the vice president of Maritime Programs for Zenetex, LLC, a company that provides management and technology support services to federal government agencies and commercial organizations in the U.S. and internationally.

McNeal comes to Carderock from NAVSEA, serving as the deputy major program manager for the Guided-Missile Frigate (FFG(X)) Program.

During his speech after taking command, McNeal told the crowd of friends, family and Carderock employees that the day wasn't really about him, but about Vandroff, who he said paved the way for the next generation of engineering duty officers like himself.

Capt. Cedric McNeal (second from left) relieves Capt. Mark Vandroff (second from right) as the commanding officer of Naval Surface Warfare Center, Carderock Division in a ceremony May 3, 2019, in the Maritime Technology Information Center at Carderock Division in West Bethesda, Md. From left, U.S. Army Col. Laurence Bazer, deputy director for the Office of the National Guard, Joint Chaplains Office; McNeal; Capt. Andy Arnold, chief of staff, Naval Surface and Undersea Warfare Centers; Vandroff; Rear Adm. William Galinis, Program Executive Officer, Ships. (U.S. Navy photo by Nicholas Brezzell/Released)

"You've been a mentor and a role model, a pillar in the shipbuilding community, truly skillful at the aspects of program management and shipbuilding, and a walking body of knowledge for naval history, acquisition excellence and whatever else you may want to learn about in life," McNeal said to Vandroff.

McNeal acknowledged the reputation of Carderock employees for their technical excellence and delivery of world-renowned capability in platform integrity, ship signatures and surface ship and submarine design and integration, but added that there was still work to be done.

"Vice Adm. (Thomas) Moore (NAVSEA commander) is calling for us to expand the advantage through enabling the talents of our workforce, instilling a culture of affordability by making every dollar count and ensuring innovation and collaboration in our efforts to achieve learning at high velocity across the enterprise," McNeal said. "I'm beyond ecstatic about seeing what lies ahead, the cutting-edge technological advancements that will come from this team here at Carderock, contributing to the capabilities that will shape the force of our next generation Navy, all in support of the defense of our great nation."

Carderock researchers contribute to book on ship stability

By Kelley Stirling, NSWCCD Public Affairs

To say this book is a collection of research would be an understatement. "Contemporary Ideas on Ship Stability: Risk of Capsizing" is more like a preservation of knowledge covering the last nine years.

Dr. Vadim Belenky, a naval architect in the Simulations and Analysis Branch at Naval Surface Warfare Center, Carderock Division, was the editor in chief for the book, the chapters of which are papers from engineers, naval architects and professors from around the world. Belenky himself co-authored four of the papers, along with 15 other current or former Carderock employees who authored these papers.

Carderock's Dr. Art Reed was a co-author on the first chapter of the book, "TEMPEST—A New Computationally Efficient Dynamic Stability Prediction Tool." His co-author was Bill Belknap, a former Carderock employee and now a technical warrant holder at Naval Sea Systems Command (NAVSEA).

The abstract for chapter one says, "TEMPEST is designed to be computationally efficient to support real-time training simulators, as well as high-resolution evaluation of surface-ship, dynamic-stability performance across a wide range of possible environmental conditions. TEMPEST aims to improve the state of the art for real-time computations through the inclusion of nonlinear (body-exact) hydrodynamic perturbation forces and physics-based, viscosity-influenced lift and cross-flow drag forces."

Reed, the senior research scientist and technical consultant for high-speed ship hydrodynamics, said TEMPEST has been very important software in the field of dynamic stability research, and it was a multi-million-dollar investment for the U.S. Navy.

Reed said that having this chapter start the book just showcases the important contribution Carderock has made to the world in the realm of fluid mechanics. He said basing stability assessments solely on previous experience doesn't allow for novel, unconventional design.

"This book provides an avenue by which the international community concerned with the stability of ships can learn of and be informed about the work on ship stability that we here at Carderock have performed," Reed said.

Belenky said that while the research in the book, much of it experimental in nature, was not published in peer-reviewed journals, it deserved to be preserved in the form of this book, which seeks to highlight contemporary research that results in products like TEMPEST.

Dr. Jack Price, Carderock's director of research, said having this research in a one-volume piece of referable materials is very helpful to anybody in the field.

"It really is a compilation of the knowledge of the field as it is right now," Price said.

He said that within the Navy, there's a tendency to focus on the advanced engineering and engineering integration that Carderock does, without the understanding that there's a lot of comprehensive research and foundational research done at Carderock that only Carderock can do.

"We are the only Navy entity that has this understanding and they (the Navy) rely upon us, even if they don't realize they do, to maintain that research capability," Price said. "Because if we didn't do it, for the naval applications that we do, there wouldn't be anybody in the world that could do that for us—anybody we would trust."

While the book does include research from laboratories and universities worldwide, the Carderock contribution contains the necessary research specific to the Navy as the seaborne branch of the U.S. military.

Reed said the research presented in this book has been and is being used in support of several ship-design efforts. The statistical methods are being used to provide quantitative metrics as to the bounds of Carderock's seakeeping experimental results; the statistical-extrapolation methods are being used to develop operator guidance and safe-operating envelopes for use aboard ships; and the more fundamental techniques for assessing stability are being investigated for use to provide dynamic stability assessments during early-stage design.

"It serves as a resource that anyone needing to assess ship stability can use to develop their own methodologies. This includes intact stability; damaged stability; stability in waves; the verification, validation and accreditation of assessment tools; etc.," Reed said. "This is becoming critical with the International Maritime Organization planning to issue its Second Generation Intact Stability guidance in the next year."

According to Reed, the book serves as a mechanism to showcase the valuable work being done at Carderock to their sponsors, both internal and external, who can then show their superiors the significance of supporting this important work.

"These papers would not have been chosen by the international editorial board if the work did not constitute a valuable contribution to the literature," Reed said.

The book contains material from two International Ship Stability Workshops and one International Conference on

Stability of Shops and Ocean Vehicles: the 2010 workshop at Wageningen, Netherlands; the 2011 workshop in Washington, D.C.; and the 2012 conference in Athens, Greece.

Belenky worked with four other editors to make the selections for the book: Dr. Kostas Spyrou from the National Technical University of Athens in Greece; Dr. Frans van Walree from the Maritime Research Institute Netherlands; Dr. Marcelo Almeida Santos Neves from the Federal University of Rio de Janeiro in Brazil; and Dr. Naoya Umeda from Osaka University in Japan.

"We pick the most important contributions that were not published in journals, and that will make into the book," Belenky said.

The book has four major parts:

Part A: Mathematical model of ship motions in waves (15 chapters)
Part B: Dynamics of large motions (12 chapters)
Part C: Experimental research (11 chapters)
Part D: Requirements, regulation and operation (17 chapters)

Belenky said that each chapter had two independent reviewers, mostly authors looking at other chapters. The reviewers were able to send the authors their comments, thus giving them an opportunity to make adjustments to their research.

"They could significantly change their paper, or update it since it was happening over the course of a few years. This allowed them to improve the content, make it modern," Belenky said, adding that this is the point of the book, to accumulate relevant knowledge in ship stability and preserve it.

Dr. Vadim Belenky, a naval architect in the Simulations and Analysis Branch at Naval Surface Warfare Center, Carderock Division, holds a copy of "Contemporary Ideas on Ship Stability: Risk of Capsizing," a compilation of papers from engineers, naval architects and professors from around the world, for which he was the editor in chief. (U.S. Navy photo by Kelley Stirling/Released)

Little Creek taking big steps for technical excellence

By Ryan Hanyok,
NSWCCD Visual Information Branch

The engineers at the Combatant Craft Division (CCD) in Little Creek, Virginia, are faced with a good problem to have: they are being asked to do more of the work they love. The concern for Carl Casamassina, senior principal naval architect and marine engineer, is how will CCD grow to meet workload demands without sacrificing quality?

CCD is a detachment of the Naval Surface Warfare Center, Carderock Division and the center of expertise for high-performance boats and crafts. Any solutions to manage its new-found growth requires deep appreciation for what makes this outfit valuable to its customers.

"We're like a microcosm of NAVSEA (Naval Sea Systems Command)," Casamassina said. "We provide cradle-to-grave, technical and logistical support for all U.S. Navy boats and craft. We not only do the initial work, we typically own the follow-on work, as well."

Casamassina's experience as the deputy technical warrant holder and acting chief engineer for the detachment taught him that transitioning this period of rapid growth successfully would require more than a few new hires. CCD needed to consider how to work within its current constraints, establish clear objectives for the detachment, develop processes to maintain balance, and at the center of it all, uphold a standard of technical rigor. In Casamassina's words, "champion technical excellence."

"Our people are our greatest resource, but they were all bottled up in a stove-piped structure," Casamassina said. "So the leadership team (led by division head and site director Kenneth "Kip" Davis) looked into it and realized the best way to unlock our peoples' latent potential and manage resources was to reorganize as a matrixed structure."

Unlike a traditional pyramid hierarchy, a matrixed organization is "flatter." Project leads in CCD now have better access to technical expertise and business functions

Naval Surface Warfare Center, Carderock Division's Combatant Craft Division boats are pier side at Naval Station Norfolk on April 27, 2017. (U.S. Navy photo by Kelley Stirling/Released)

elsewhere in the organization. From Casamassina's technical perspective, this freer structure needed to be balanced by stronger quality-control processes to ensure a standard of rigor was executed across the organization. In the midst of Combatant Craft Division developing new quality-control regimes, Carderock Division released the project framework that established higher standards of rigor for all projects.

"The timing of the project framework rollout worked out great," Casamassina said. "The framework requirements aligned nicely with our reorg goals and, as it turns out, we were already doing much of it."

However, some customers of CCD worried its reorganization would increase the cost to them and affect CCD's ability to provide the same level of service.

"After a senior leadership briefing of our reorg, a primary customer was so impressed by our approach he said, 'Wow, we might do this with our own organization,'" Casamassina said. "As pleased as we were with the show of confidence, it's important to recognize the reorg was a suitable solution for us, not necessarily everyone."

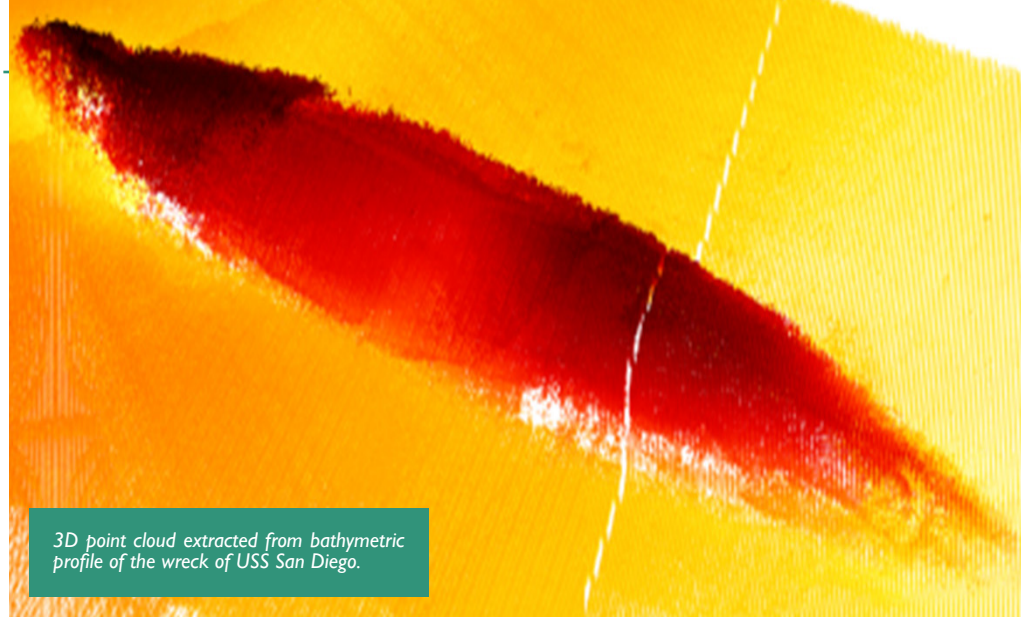
Casamassina defines technical excellence as increasing the quality of CCD's products, while balancing cost, schedule, performance and risk. By performing all of this with the utmost levels of technical rigor, technical excellence becomes attainable. The reorganization, complemented by the project framework, ensures technical excellence remains at the core of CCD's operational ethos.

"In the end, we are trying to give the end user, the warfighter, the best possible product and/or service." Casamassina said. "To champion technical excellence, we must constantly reassess how best to achieve our objectives and balance them with current constraints and good processes."

Carderock engineers, using NISE 219 funds, help discover what sank WWI cruiser USS San Diego

From Naval History and Heritage Command

USS San Diego (Armored Cruiser No. 6) serves as flagship of the Pacific Fleet on Jan. 28, 1915. (U.S. Naval History and Heritage Command photograph/Released)



3D point cloud extracted from bathymetric profile of the wreck of USS San Diego.

The Navy announced its findings into what sank the World War I cruiser USS San Diego (ACR-6) after a two-year study at the American Geophysical Union's fall meeting on Dec. 11.

Dr. Alexis Catsambis, an underwater archeologist at the Naval History and Heritage Command, based at the Washington Navy Yard, led the project and chaired a panel discussion about the findings at the event. Although the original court of inquiry believed the explosion that sank the 500-foot armored cruiser in 1918 was caused by a mine, later speculation raised the theory that it might have been a torpedo.

Dr. Ken Nahshon, an engineer in Carderock's Hull Response and Protection Branch, and Dr. Arthur Trembanis, an associate professor at the University of Delaware's College of Earth, Ocean and Environment in Newark, sat on the panel discussion to answer questions about the research.

After examining new survey data, additional archival research, computer impact and flooding models, the area of the ocean floor in which the wreck rests and other elements related to the ship's loss, Catsambis announced that the research team believed the explosion's cause was a mine.

"The legacy of the incident is that six men lost their lives on July 19, 1918," Catsambis said. "With this project we had an opportunity to set the story straight and by doing so, honor their memory and also validate the fact that the men onboard did everything right in the lead up to the attack, as well as in the response. The fact that we lost six men out of upwards of 1,100 is a testament to how well they responded to the attack."

Researchers from Naval Surface Warfare Center, Carderock Division (NSWC Carderock) in West Bethesda, Maryland, using Naval Innovative Science and Engineering (NISE)/Section 219 funds, provided engineering support to the Navy History and Heritage Command to help determine the cause of San Diego's sinking.

Using historical analysis, archaeological research, site investigation and Carderock-developed impact and flood modeling tools, the research teams were able to eliminate other possibilities that might have caused San Diego's sinking such as sabotage, accident or enemy torpedo.

Trembanis explained how the use of underwater robotics and remotely deployed instruments, including an autonomous underwater vehicle, allowed researchers to collect high-resolution 3D images of the site to support their conclusion. Nahshon worked with Michael Kipp, an engineer from Carderock's Weights, Stability and Reliability Branch, as principal investigators in analyzing field survey results and weapons attack and flooding sequences relating to San Diego. Together with Jeevan Nalli and Benjamin Ridenour of Carderock's Vulnerability Assessment Branch, they were able to integrate software tools for performing whole-ship dynamic flooding (FLMASA-Flooding Model Advanced Stability Algorithm) and vulnerability analysis (ASAP—Advanced Survivability Assessment Program), for the development of a common vulnerability and flooding model, ultimately creating a digital twin of a damaged ship.

Nahshon said they were able to compare the 3D modeling data to the initial undamaged state of San Diego, and using the dynamic flooding software along with weapons effects assessment, they could calculate flooding patterns and quantify the loss of stability resulting in capsizing and sinking of the ship.

"The format of the 3D modeling data makes analysis readily comparable, but below-water collecting of 3D data at the sea floor is very challenging and requires immense expertise to interpret," Nahshon said. "Through this NISE project, we have gained valuable experience in both understanding how this data is collected and processing the results to inform damaged ship assessments."

Before taking questions, Catsambis shared why this research is important for the U.S. Navy and how learning from the past will help to prepare for the future.

"The collection of archeological and hydrographic data establishes a baseline, informing site formation processes and management of USS San Diego," Catsambis said. "Lessons learned here are applicable to other U.S. Navy sunken military craft. This endeavor also provided real-world training opportunities for U.S. Navy divers, archaeologists, historians, modelers, naval engineers and graduate students."

In July 1918, the 15,000-ton armored cruiser San Diego sank off Long Island, New York, losing six Sailors from a crew of 1,100. German submarines had mined the coast, implicating a mine. But the ship's captain was perplexed that the explosion occurred aft of the ship's widest point, which gave rise to the notion the explosion might have been caused by a torpedo even though no submarine or torpedo trail had been spotted.

Later theories suggested a coal bunker explosion or sabotage, but the source of the explosion remained a mystery.

To commemorate the 100th anniversary of the loss of San Diego, the only major U.S. Navy warship sunk in World War I, a multi-partner investigative campaign dubbed the USS San Diego Project was launched in 2017—mapping the wreck, assessing the wreck's state of preservation, modeling its sinking and uncovering the weapon that likely sank it.

Kelley Stirling from NSWC Carderock contributed to this article.

Helmets coated with explosive-resistant coating are positioned for blast testing to evaluate the effectiveness of the coating. The work done in this research was patented in 2018. (U.S. Navy photo by Philip Dudt/Released)

Blast and ballistic improvement in helmets

By Benjamin McKnight III, NSWCCD Public Affairs

The United States Armed Forces have seen a great amount of advancement in the technology behind protective gear through the years. With each conflict, a newer challenge was presented for more sufficient equipment. Philip Dudt, an engineer in the Hull Response and Protection Branch at Naval Surface Warfare Center, Carderock Division, was recognized for his effort to the cause in 2018 when an invention he contributed to was awarded a patent.

In Dudt's 50 years at Carderock, he has been a part of multiple teams of inventors to receive patents on various products. His most recent work went to Patent No. 9,869,533, Blast and Ballistic Improvement in Helmets. Working with four other engineers, Dudt's challenge was to create a material for helmets that would adequately protect its wearers against explosive blast, in addition to bullets. Blast exposure has been associated with traumatic brain injuries.

According to Dudt, helmets have traditionally prioritized stopping bullets. The years of recent conflicts in the Middle East introduced warfighters to increased threats of roadside bombs and improvised explosive devices (IEDs), likewise creating the need to focus on protecting service members from the blast. As of the first quarter of 2018, the Department of Defense reported over 380,000 traumatic brain injury diagnoses since it began keeping record in 2000, per the Defense and Veterans Brain Injury Center website.

The root of this effort started when Dudt and his peers were looking for ways to improve blast protection on ships. He cited the attack on USS Cole (DDG 67) in October 2000, which killed 17 U.S. Sailors, as one of the inspirations behind their original research. Work focused on special coatings that have the ability to increase strength and stiffness under shock and blast loads. As they saw successes in their experiments, a collective epiphany surfaced.

"We said, 'What if we just try coating a combat helmet? Could it affect the level of damage that the brain could experience?'" Dudt said.

The keys to this assessment were efforts by Carderock's Dynamic Instrumentation Group, where Bill Lewis designed a full-scale instrumented head-neck manikin, and the Non-Metallic Materials Research and Evaluation Branh's polymer group's facility for applying the coatings.

"When we put the coating on the helmet, it did quite help quite a bit," Dudt said. Intracranial accelerations and impulses were significantly reduced. Their major drawback: the considerable increase in helmet weight. "You put the coating on the helmet and it's seven pounds instead of almost five."

Dudt said that DuPont USA, a major helmet designer, proposed working with his team by making thinner helmet shells with stronger materials to negate the increased weight disadvantage. An even lighter overall weight helmet compared to the conventional design was a final result.

Blast testing was done on the Navy side of the project using the Carderock test pit and against full-scale IEDs at the Navy's explosive ordnance disposal facility in Indian Head, Maryland, while DuPont took care of ballistic testing to ensure that the change didn't compromise the helmet's original intent of defeating bullets.

As the collaborative efforts increased, both parties decided it was worth filing a patent together, so DuPont and the Navy filed the patent in April 2015. In addition to Dudt, there were four other engineers who contributed to the invention: Bryce VanArsdalen (DuPont), Dr. Roshdy Barsoum (Office of Naval Research), Alyssa Littlestone (Naval Sea Systems Command, formerly at Carderock) and Dr. Charles Roland (Naval Research Lab).

There is not a full agreement in the medical community on the causes of traumatic brain injury to date. Within the patent, the invention description identified numerous possible causes linking blasts to traumatic brain injuries. These factors included skull flexure, blast-induced cerebral spinal fluid cavitation, brain axonal stretching and direct pressure pulse transition into the brain.

"Everyone can agree that it is important to lower the brain's exposure level to the injury-causing parameters the coating mitigates," Dudt said.

The research for this invention looked at brain injuries as a whole, but other investigations were started to focus on specific structures and regions of the brain.

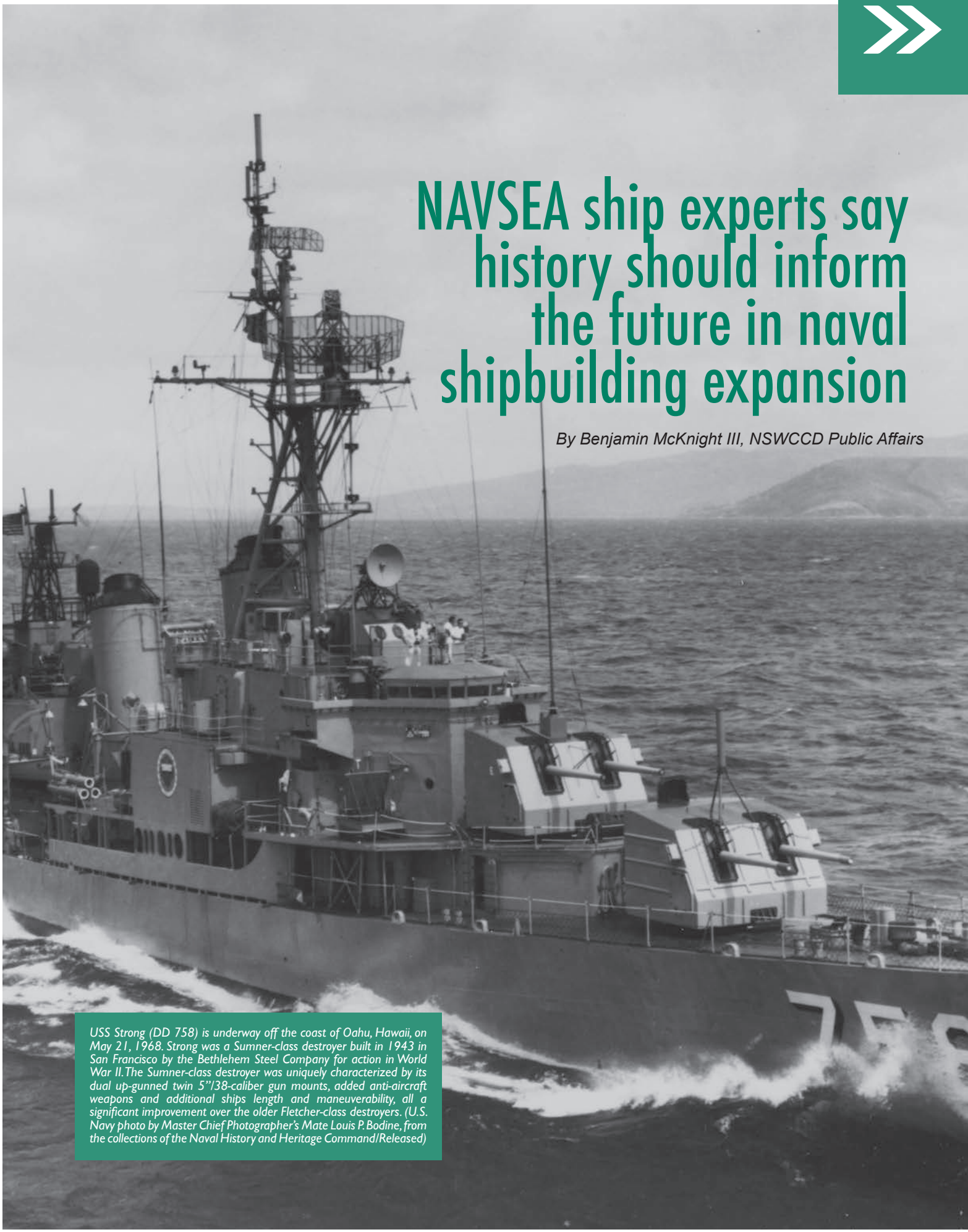
"Regardless of the underlying mechanism, it is agreed by all that it is important to limit the level of blast exposure to the brain," the patent reads.

For the time being, Dudt's work on the blast-protection concept is complete. On the idea that there could be a chance that blast and ballistic improvement can reach other forms of protective equipment, Dudt said, "I think the testing just hasn't been done yet." And while the patent hasn't turned into a mass production of new helmets for service members, the technology implemented in this patent process indicates that it is a possibility for the future.

Helmets with explosion-resistant coating endure a blast test to measure the effectiveness of the coating. (U.S. Navy photo by Philip Dudt/Released)

NAVSEA ship experts say history should inform the future in naval shipbuilding expansion

By Benjamin McKnight III, NSWCCD Public Affairs



USS Strong (DD 758) is underway off the coast of Oahu, Hawaii, on May 21, 1968. Strong was a Sumner-class destroyer built in 1943 in San Francisco by the Bethlehem Steel Company for action in World War II. The Sumner-class destroyer was uniquely characterized by its dual up-gunned twin 5"/38-caliber gun mounts, added anti-aircraft weapons and additional ships length and maneuverability, all a significant improvement over the older Fletcher-class destroyers. (U.S. Navy photo by Master Chief Photographer's Mate Louis P. Bodine, from the collections of the Naval History and Heritage Command/Released)

Lessons learned from history helped focus the nation's shipbuilding efforts moving into World War II and beyond, according to Dr. Norbert Doerry and Dr. Philip Koenig, both from Naval Sea Systems Command (NAVSEA). The two men were the speakers for the monthly Rear Adm. David Taylor Naval Architecture Lecture Series at Naval Surface Warfare Center, Carderock Division, in West Bethesda, Maryland, on June 13.

The lecture, titled "Naval Shipbuilding Expansion: the World War II Surface Combatant Experience," took the audience through four eras that the speakers identified as being instrumental in the successes of the U.S. Navy expansion efforts during the second world war. Although World War II was the primary focus of the lecture, Koenig said it was equally important to discuss the years prior to have a better understanding of the U.S. Navy during and after World War I.

"They say you can learn a lot from failure," said Koenig, director of NAVSEA's Industrial and Economic Analysis Division. "So we want to look at the failed World War I industrial expansion, and then see what happened correctly in World War II."

Koenig began with the World War I era, going up to 1922, followed by the treaty period from 1922-1936. After that was the pre-World War II era of 1936-1941 and finally World War II from 1941-1945, which was covered by Doerry, technical director of the NAVSEA Technology Office. According to Doerry, World War II was the last "industrial war" for the United States, but he said the current international landscape could possibly require the nation to be able to navigate a modern version of such.

"There's nobody in the government who has experienced our last industrial war, and most of those people who have aren't even alive now," Doerry said. "We would be closer in tune to the World War I experience in terms of the people in leadership within the Navy and industrial practices."

During World War I, the Navy acquired 273 destroyers. Only 41 of those vessels made it to sea before the end of the war, with the rest being commissioned after the war. In the time between the first and second war, 105 of those ships were lost or scrapped, and the rest served during World War II, Koenig said.

At the time, the biggest challenges for the Navy were that preparations for the mass production of ships was not a priority because there was no precedent for World War I. Furthermore, the ship types that were actually needed in combat differed from what was built in the pre-war era.

Following World War I, naval treaties slowed the production of sea vessels, but when the treaty restrictions ended and a second world war was on the horizon, the Navy became proactive and Congress authorized the construction of over 180 new destroyers. Because the shipbuilding process takes time, the Navy was composed mostly of ships built in the World War I and treaty eras going into the first year of World War II.

"Those World War I destroyers were the best destroyers in the world in 1916, but this is 1941," Doerry said. "(Secretary of Defense) Donald Rumsfeld said in 2004, 'You go to war with the Army you have, not the Army you might want or wish to have at a later time.'"

By year three of World War II, at least a quarter of the Navy's destroyer fleet consisted of more ships that were modern, although the biggest bulk of vessels were pre-war era ships that were still in construction during the first two years of the war. It was not until the final year of the war that the fraction of commissioned destroyers authorized between 1942 and 1943 approached half the destroyer fleet. However, in the seven-year span from the end of the pre-war era to the end of World War II, the number in gross tons of steel merchant ships produced per year skyrocketed from a nearly negligible amount to almost 13 million tons at its peak in 1943.

Most of the heavy losses of destroyers in the war happened in the first few years when the fleet was still mostly outdated ships. According to Doerry, there are very few exceptions where ships designed during the war entered prior to the end of fighting. He said that production of ships was not an easy feat, but a doable one with the right allocation of efforts.

"High-volume production will not happen without expansion in industrial capacity, both in the shipyards and in their supply chains," Doerry said.

As the demand for faster-produced ships increases in today's world, Doerry and Koenig stressed the importance of the Navy being able to adapt with the rapidly evolving technologies that go into shipbuilding. From design features to weapons and computerized systems, they said a slow response to a threat will put lives at risk. U.S. military conflicts since the Cold War have been primarily land fights, deemphasizing the nation's need to expand the fleet. Since then, Doerry said the naval ship acquisition processes have changed and with the onset of this Great Power Competition, the Navy must ensure that the new approach to fleet expansion draws from the lessons of previous failures and successes.

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. Part the of the Defense Advanced Research Projects Agency's Anti-Submarine Warfare Continuous Trail Unmanned Vessel program, in conjunction with the Office of Naval Research, is working to fully test the capabilities of the vessel and several innovative payloads, with the goal of transitioning the technology to Navy operational use once fully proven. (U.S. Navy photo by John F. Williams/Released)

McAllister talks future of unmanned vehicles

By Benjamin McKnight III, 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, System 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," McAllister said "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 every week, where 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 dollar budget to acquire significant numbers of unmanned maritime systems (UMS) 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."

Members of Naval Sea Systems Command's Unmanned Maritime Systems group attend the Unmanned Vehicles and Autonomous Systems Working Group workshop on March 22, 2019, at Naval Surface Warfare Center, Carderock Division in West Bethesda, Md. The purpose of the workshop was to discuss the development, testing, fielding and sustainment of the unmanned portfolio. Pictured third from right is Capt. Pete Small (PMS 406) and second from right is Carderock's Reid McAllister. (U.S. Navy photo by Kelley Stirling/Released)

Measuring manufactured parts

Brett Griffith uses a 3D optical metrology scanner to measure a manufactured part for quality control on March 14, 2019, in the Model Fabrication Shop at Naval Surface Warfare Center, Carderock Division in West Bethesda, Md. (U.S. Navy photo by Ryan Hanyok/Released)

Innovation
at work

Carderock paint researchers help extend life of U.S. Navy ships

By Edvin Hernandez, NSWCCD Public Affairs

The Corrosion and Coatings Engineering Branch at Naval Surface Warfare Center, Carderock Division faces a challenge that has cost the U.S. Navy billions of dollars in research and repairs—corrosion.

Engineer Dr. Charles White and chemist Dr. Kylee Fazende test and evaluate paint and coating products that aim to mitigate corrosion on Navy ships.

Paint fulfills more than an aesthetic purpose in America's fleet. The need to stay camouflaged and undetected at sea calls for efficient ship coating, which requires a series of tests to determine the paint's survivability in different sea-state environments. Factors such as exposure to sunlight, temperature and biofouling, to name a few, are taken into consideration before deciding which coat of paint is best to apply onto a hull. All decisions must meet the requirements and qualifications of Naval Sea Systems Command's (NAVSEA) standard item numerical index and be approved by their corresponding technical warrant holders.

Each part of a hull is coated differently to accommodate the potential environment and influencing variables. For example, the coating used on the outside of a ship, which is exposed to warmer temperatures, will be different from the coating used on the inside of a ship, which will be cooler and air-conditioned.

"Anti-condensation coatings are used outside air-conditioned habitable spaces, but a lot of other parts of the ship do not have that commodity. In those air-conditioned spaces, the surrounding bulkheads will start condensing water because of the difference in the temperature inside and outside," Fazende said. "So you have to factor in that there's going to be standing water on this wall permanently when selecting a proper coating."

At the Philadelphia Navy Yard, some pierside ships have been uncontrollably bleached into a bright pink color. The discoloration of the hulls was caused by intense sunlight exposure that chemically broke down the polymer, affecting the pigment of the vessels in the process.

"The biggest enemies to any exterior coating that you have

Chemist Dr. Kylee Fazende loads paint panels onto the cyclic corrosion chamber for initial testing at Naval Surface Warfare Center, Carderock Division's Accelerated Exposure and Weathering Lab on April 4, 2019. (US Navy photo by Edvin Hernandez/ Released)

are sunlight, water and salt. The sunlight itself will cause the breakdown of the polymer, and the water will soak into the polymers and can cause delamination and corrosion," White said, adding that the danger of water seeping into any cracks within the coating is that it can either evaporate and freeze or otherwise erode the coating and cause performance failure.

According to White, paints are not one size fits all; therefore, some coatings are made for special purposes to accommodate demanding environments. Specialty coatings have precise formulations and are made in a specific way using certain ingredients, Fazende said. For example, the specialty coating for nonskid flight-deck material must be able to withstand mechanical wear and a challengingly hot surface.

While the coating material is important, it is imperative to select an appropriate color, too.

"A black coating can work really well for some applications and deck camouflage, until you start factoring how much sun it is going to absorb. You can get elevated deck temperatures very quickly," warned White.

Polysiloxane paint, which recently replaced silicone alkyd, has demonstrated its superiority in color retention, UV resistance and adhesion over its predecessors. Latex paint, which is used to paint homes, would struggle to survive in the intense environment.

At Carderock's West Bethesda, Maryland, headquarters White and Fazende use special chambers to test coated panels in an accelerated environment.

"What we do here is shorter term, so it's our way of being able to test the paints and be able to get an idea of how their performance is going to be. We have accelerated light exposure, salt spray and salt fog, which simulates what the ships would actually experience with humidity, water coming off of the waves and salt content in the air," Fazende said.

According to White, this is a way to test quickly and give manufacturers some criteria before they invest their time and money on multi-year long projects.

After initial testing, White and Fazende travel to one of Carderock's Florida detachments to run and monitor real-world exposure tests.

"We do a lot of laboratory testing here (West Bethesda site) to troubleshoot problems and conduct failure analysis. Kylee and I specifically paint panels that go down to our South Florida Ocean Measurement Facility (in Dania), where we do a lot of corrosion studies for the Marine Corps and for the Navy," White said. "We can also take a specific piece of equipment like a window latch or truck bed down there and do atmospheric exposure and biofouling studies in an aggressive environment like south Florida."

Marine life contributes to the corroding effects of paint coating, as well. Although White and Fazende do not work closely with this focus, they are aware of the paints available to discourage biological growth.

"There is another team within our code (at Carderock) that focuses on that, but they use other coatings such as ablative coatings. It's a thick coating that erodes when the hull begins to move, dropping the critters along with it," White said.

Another way to discourage biological growth on a ship is the application of antifouling paint. The slippery paint does not allow any marine life to latch on and slides the little critters off.

"Biological growth on hulls causes additional friction in the water, requiring more energy for the propeller to get the same speed and potentially damaging the rudder," White said.

The joint effort to combat corrosion for the Navy and Marine Corps is essential to keeping equipment healthy and performance ready.

"Corrosion is one of those complicated multivariate processes that is difficult to control by addressing only one variable. Many pathways for corrosion propagation and control exist, and the Corrosion and Coatings Engineering Branch is structured to address them as a team to make sure the Navy platforms and equipment stay in the best condition," White said

Harrison talks about 'not quite dead' s

By Brooke Marquardt, NSWCCD Public Affairs

James Harrison, the director of the Expeditionary Warfare Ship Division at Naval Sea Systems Command (NAVSEA), was at Naval Surface Warfare Center, Carderock Division on Feb. 13 presenting a brown-bag lecture on damaged ships that just were not ready to sink. Titled "I'm Not Quite Dead Yet," the lecture focused on ships that sustained large amounts of damage and kept operating. In addition to the presentation being interesting and humorous, Harrison hoped that it would also highlight why survivability is an important factor to consider in naval ship design.

One of the first vessels Harrison discussed was USS Squalus (SS 192). A submarine commissioned in the late 1930s, she was running test dives off the coast of New Hampshire in 1939. Before submerging, Sailors did not close the main induction valve, which ultimately flooded half of the submarine, including compartments like the torpedo room, the engine room and the battery shop. One of the Sailors who was closing the door recalled that he saw a close friend of his coming towards the door, but had to close the door before he got there to prevent further flooding. Out of the crew of 59, 26 Sailors were lost.

The sub bottomed out in 243 feet of water, where her sister ship saw the emergency buoy and had enough information to know that there were survivors. USS Falcon (AM-28) was rushed from Groton, Connecticut, and set up a rescue effort with a McCann Submarine Rescue Chamber, a bell-shaped chamber that was lowered to the submarine and attached. The first ride brought up seven Sailors, the second and third brought up nine, but on the fourth run, the line partially parted and the chamber sank back down. The crew of the Falcon then hand-over-hand pulled this chamber back to the surface and rescued the final eight survivors, including the commanding officer (CO).

The concern then became that one of the U.S. Navy's newest submarines was sunk

USS Enterprise (CV 6) landing an aircraft while supporting the Gilberts Operation in November 1943. (U.S. Naval History and Heritage Command Photograph/ Released)

ships

just off the coast of New Hampshire, and the Navy launched a salvage effort. The first effort involved attaching pontoons to the submarine and bringing her to the surface, but once on the surface, the pontoons detached and she sank again. It took 628 dives to get her back to dry dock. She was recommissioned in 1940 as USS Sailfish (SS 192), and the CO later made it a punishable offense to use the name Squalus, although the nickname for the ship among the fleet was "Squailfish."

"Arguably, it is one of the most successful rescues of submariners from a sunk submarine and one of the reasons we keep the submarine-rescue research efforts going. It is one of the international standards that we have, not only with our Allies, but also our enemies; everyone agreed on how you would get submariners out of a submarine that sank," Harrison said.

In addition to U.S. Navy ships, Harrison also discussed German navy ships like the Schamhorst and Gneisenhau. For these two battlecruisers, the primary mission was for them to act as commerce raiders, not to fight other battleships. Harrison compared the lives of these ships to video games: once you get past the introductory level, the levels get harder and harder. The British ship HMS Rawalpindi was a converted ocean liner, had eight six-inch guns, completely unarmored and was in the Iceland gap between the Norwegian Sea and the Atlantic Ocean on blockade duty in November 1939 when she came across these ships. The Rawalpindi CO's final message was, "We'll fight them both, they'll sink us and that'll be that. Good-bye."

The ships later suffered structural damage due to rough seas and were repaired. They went on to take torpedo damage and need repairs. When they were sent on missions in seas near France, they took on bomb after bomb from air raids, continually needing repairs. In February 1942, they were called back to Germany, where they could be better protected. This was Operation Cerberus, also known as the "Channel Dash," and despite numerous attacks from aircrafts and ships, the British and their Allies caused no further damage to these passing ships. "Not their best day," Harrison said of the Allied forces.

Once the Schamhorst and Gneisenhau made it out of British danger, they promptly ran into mines. Both damaged, they needed to be repaired yet again. A cautionary tale emerged from the attempted repair of the Gneisenhau: do not go into dry dock with the magazines loaded. A bomb went off in one of the magazines and finally ended Gneisenhau's career. Both of these ships spent more time damaged than not during the course of their careers. The Schamhorst was then sent to Norway alone and was again damaged by the rough seas and repaired. Here she entered her final action, the Battle of North Cape. She fought a battleship, a heavy cruiser, three light cruisers and nine destroyers in a blizzard over three engagements. The first engagement knocked out her radar; she survived the second engagement, but did not survive the third. Out of a crew of 1,968 Sailors, only 36 were picked up by the enemy.

Also during World War II, the U.S. Navy's USS Enterprise (CV 6) was attacked in six separate events over the course of three-and-a-half years, and the Japanese reported her sunk four or five of these times. Enterprise sustained bomb damage from multiple battles, to include the Battle of Santa Cruz in October 1942, where the Japanese were introduced to new technology the U.S. Navy had—radar-fused anti-aircraft shells. These were designed to sense when they were approaching something and when it was at the right distance, it exploded.

"This is one of the greatest secrets that the U.S. Navy had during World War II. This set the stage for U.S. anti-aircraft efforts from then on, as surface ships became able to largely defend themselves in a way that they were incapable of before," Harrison said.

The Enterprise was damaged a few more times before March 1945, when she was damaged again by friendly fire. In May 1945, off the coast of Okinawa, Japan, she was hit with two kamikazes and was taken out of service two months before the end of the war. She earned 20 battle stars, more than any other battleship. The success of this ship left a lasting legacy, even today. First, her namesake lives on in Starship Enterprise from the Star Trek movie franchise. When NASA created their first space shuttle, Star Trek fans created a campaign that it be named after the Enterprise and so it was. Jack C. Taylor, founder of the Enterprise car rental company, was a World War II veteran who had served on the Enterprise.

The name Enterprise will live on as the third aircraft carrier of the Ford Class, CVN 80, which is scheduled to be operational by 2027. It will be the ninth U.S. Navy ship to bear the name Enterprise.

Dr. Nicholas Jones (front), a materials engineer in the Physical Metallurgy and Fire Performance Branch at Naval Surface Warfare Center, Carderock Division, works with his team making a paper airplane within specifications during a workshop for building systems on Feb. 14, 2019. The workshop was part of a visit by Dr. Steven Spear (standing), author of the best-selling book "The High-Velocity Edge," to Carderock's West Bethesda, Md., headquarters. (U.S. Navy photo by Kelley Stirling/Released)

HVL expert Spear: Priority has to be learning

By Kelley Stirling, NSWCCD Public Affairs

Dr. Steven Spear, author of the best-selling book "The High-Velocity Edge," visited Naval Surface Warfare Center, Carderock Division in West Bethesda, Maryland, on Feb. 14 to talk to employees about his thoughts on how being a learning organization leads to becoming a successful organization. Spear's visit was part of the Industrial Liaison Program with Massachusetts Institute of Technology, a partnership that allows the two organizations to share resources.

During a presentation, which he called "Discovering Your Way to Greatness: How the most successful organizations repeatedly get to the right answers fastest," Spear repeatedly referred to Adm. Hyman Rickover's establishment of nuclear power on Navy ships.

Spear focused on how that happened, with a lot of attention on the culture and environment that Rickover created to succeed over the adversary of the time, the Soviet Union.

"The U.S. Navy committed to nuclear power around the same time as the Soviet Union committed to nuclear power, for exactly the same reason," Spear said. "The lethality of the submarine gets multiplied, exponentially grown, enormously, by it being able to be underway for weeks and months rather than hours and days."

In 1948, the U.S. Navy started working toward the goal of atomic power on ships, and only seven years later, USS Nautilus (SSN 571) became the first submarine to sail under nuclear power.

"But in 1948, no one had controlled atomic power on anything—earth, sea, whatever, no one had it," Spear said, adding that it was Rickover's understanding of how "getting it wrong" meant learning, and learning meant the U.S. Navy not only got to the solution faster than the Soviet Union navy, but also maintained a perfect record in naval reactors, to this day.

Spear said that Rickover managed an organization where the technology and scientific developments were the second order of effect, while the first was to have a learning culture.

This is how the chief of naval operations envisions the Navy delivering on its goals and objectives. In Adm. John Richardson's "Design for Maintaining Maritime Superiority – Version 2," Richardson lists platforms and payloads he wants to see acquired under the line of effort of "Achieve High-Velocity Outcomes." In version one of the Design, the key was to achieve high-velocity learning.

Spear described the difference as basically cause and effect.

"One is the behavior for which you get the results," Spear said, advocating for the change from "plan, brief, execute, debrief" to the more dynamic planning of "plan, practice, perform, progress and promulgate," or P5.

"The priority has to be learning," Spear said, describing the P5 process as learning throughout, not just at the end, something he said Rickover's nuclear power program was known for.

He also used the example of General Motors and Toyota. Their common goal was to double fuel efficiency. Both ultimately came up with the same solution of a hybrid vehicle, but Toyota came to a solution much faster with the Prius, about 10 years faster than GM's Chevy Volt, and they produced 10 times the amount of hybrid cars over the Chevy Volt, which was just recently cancelled.

"When you ask the question, 'Why does someone succeed?' the answer is because they arrived in the moment of test. And when they arrived in that moment of test, they were prepared for the test they were facing," Spear said. "And inversely, 'Why does someone fail?' Because in the same moment of test, they arrived ill-prepared in terms of knowledge, knowing what to do and how to do it, in the terms of skills and know-how. And because they arrived ill-prepared, they weren't able to succeed."

Spear took his theory to a workshop while he was at Carderock for the day. In the "Building Systems" event, the idea was that the workers, split into two groups, needed to deliver 18 defect-free paper airplanes, all different, in sequence to the customer. They were given example airplanes and time to set up their "factory" or process before the clock started on delivery.

In the case of both groups, the workers all set to figuring out how to create the paper airplane and set up some type of assembly line. But Spear pointed out that, in most cases, no one ever asks the customer the pertinent questions upfront, which is "What do you mean by defect-free?" and "How did you make this plane?"

"We have this predilection for action, our hands are busy when our brains should be busy," Spear said, pointing out that Carderock's Dr. Nick Jones, who was part of one of the groups, actually did ask the question about the meaning of defect-free, one of only two times that has happened since Spear has been conducting that exercise.

Spear also spent time with some of Carderock's leaders. He said it's really important for leaders to create the environment where learning from failures is the rule, not the exception.

"We have to make it OK today, not just OK, but necessary, to highlight what's not working, so we can fix it through learning," Spear said. "If you do that, you have a chance of really pivoting to the direction of high-velocity learning and high-velocity outcomes."

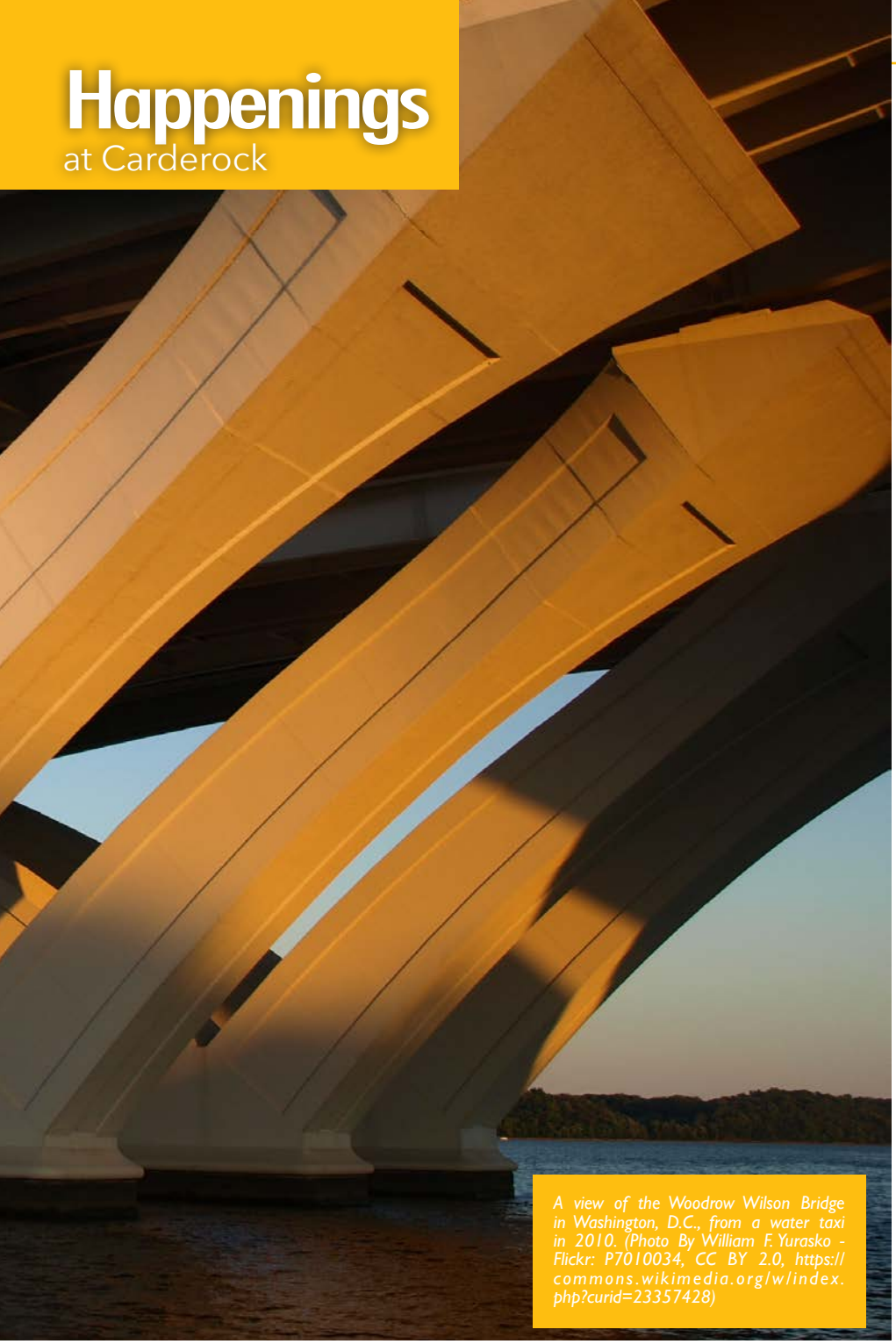
Engineers' Week features bridge project manager Jim Ruddell

By Benjamin McKnight III, NSWCCD Public Affairs

Many residents of the Washington, D.C., metro area remember a time when the Woodrow Wilson Bridge had only three lanes crossing the Potomac River for each direction of traffic. Today the bridge is much bigger, with six lanes each way, coming from an inner and outer loop of the Capital Beltway to accommodate the immense amount of traffic flowing between Maryland and Virginia.

To commemorate National Engineers' Week, Naval Surface Warfare Center, Carderock Division hosted guest speaker Jim T. Ruddell on Feb. 28 to talk about his experiences as the Woodrow Wilson Bridge replacement project manager. At the time the project was being planned, the old bridge was nearing the end of its lifespan. Ruddell, the current vice president of engineering firm WSP USA, was involved with the project from 2000 to 2009, and experienced a wide range of ups and downs throughout its duration.

The execution of the bridge project belonged to four sponsors: the respective transportation departments in Washington, D.C., Maryland and Virginia, as well as the Federal Highway Administration (FHWA). River dredging construction began in 2000, but the pre-bid meeting for the bridge construction contract was set for Sept. 11, 2001. The tragic events of that day dealt a bevy of blows to the nation, to include the construction industry. Ruddell said that their bids for the project felt an impact, so much that the headline in a Dec. 14 Washington Post article later that year read "Wilson Bridge Bid Called a 'Budget Buster.'"



A view of the Woodrow Wilson Bridge in Washington, D.C., from a water taxi in 2010. (Photo By William F. Yurasko - Flickr: P7010034, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=23357428)

That bid's price tag was $860 million, exceeding the estimated cost by $373 million. It was also the only contract bid for the project, which added a degree of difficulty to the steps taken to cut down the cost. "It took a lot of soul searching to figure out how to bring the cost of this project back into a range we could swallow," Ruddell said.

To make their plan work, Ruddell said the contract was broken up into three smaller pieces. "We felt like the construction market could consume projects of the range of $2 (million) to $3 million much better than one $600-million contract." Other measures taken included reworking the language in the contract to make it more appealing to the contractors, like reducing the insurance requirements or the performance and payment bond. The product of these steps was a set of three contract bids at total cost of $492 million, falling within 1 percent of the original estimation of $487 million.

Being in a highly congested area, one of the major goals in the project was to avoid impeding on the flow of traffic, which meant working around the traffic for as long as they could.

"We were building this job for almost six years before we touched any traffic, but we weren't playing with the lanes," Ruddell said.

Once they couldn't avoid traffic any longer, Ruddell said the contractors had to follow a very precise schedule during that phase of construction to prevent massive backups and residents' displeasure.

While Ruddell finished his involvement with the project in 2009, the entire project closed out in 2014. Much of the process was hard work with countless hours spent in meetings and in labor, but there were plentiful fun moments, as well. When the original bridge was set to be demolished in August 2006, those in charge of the project decided to add some flair to the event.

"We had a bridge demolition competition where the person with the worst commute got to push the plunger," Ruddell said. After temporarily closing flights at Ronald Reagan Washington National Airport and clearing mariners off the Potomac river, "we put on some fireworks."

Financially, the project came full circle when the finished product amounted to less than the permitted budget. According to Ruddell, the Woodrow Wilson Bridge's total project cost by its completion was $2.357 billion, which was $86 million less than the approved budget in 2001 of $2.443 billion and included added spending in throughout the project.

Whether they reside in the area or are just passing through, those who use the bridge will get to enjoy it for a long time before having to worry about new construction again. Ruddell said that the modern Woodrow Wilson Bridge is expected to function properly for 75 years. For a project faced with multiple challenges early on, the bridge is considered a modern-day success story on all fronts.

Former COMNAVSEA Sullivan packs house at Carderock for lecture on submarine safety

By Benjamin McKnight III, NSWCCD Public Affairs

Every seat in the David Taylor room at Naval Surface Warfare Center, Carderock Division was filled on Feb. 14 to hear retired Vice Adm. Paul Sullivan's lecture on submarine safety. Having served as the 41st commander of Naval Sea Systems Command, Sullivan's presence alone brought a wealth of experience for his audience to glean from.

His lecture, titled "Submarine Safety: Legacy and Culture," part of Carderock's Rear Adm. David Taylor Naval Architecture Lecture Series, was both a history lesson and a presentation on modern submarine safety.

In a perfect world, all naval equipment would operate to perfection. Since that is not the case, every system needs plans of action when malfunctions or damages occur. Underwater vessels have a lower margin of error if something catastrophic happens. According to Sullivan, however, that is part of the cycle that produces future safety measures.

"How do you get a safety culture? It's a journey, and it's generally brought on by

Retired Rear Adm. Paul Sullivan, formally the 41st commander of Naval Sea Systems Command, speaks on the importance of the Navy's Submarine Safety (SUBSAFE) program on Feb. 14, 2019, at Naval Surface Warfare Center, Carderock Division's Rear Adm. David Taylor Naval Architecture Lecture in West Bethesda, Md. (U.S. Navy photo by Ryan Hanyok/Released)

tragedy," Sullivan said. He then presented a diagram to explain the steps that occur following said tragedy. Initially, recovery, analysis and corrective actions take place.

"With each disaster, we learn more lessons," he said. Once the errors are studied and improvements are applied, the end product is a "successful safety culture."

Ideally, the cycle would end there, but with success comes complacency, according to Sullivan. The safety culture process takes years, so those who are in charge while a system is operating at optimal functionality are typically not the ones who dealt with the previous disaster.

"A couple generations of leadership and middle-management changeover and all of a sudden you're being led by people who did not experience the tragedy," Sullivan said. "So you get complacent and guess what happens? You get another tragedy."

One of those tragedies was the loss of USS Thresher (SSN 593) in 1963. The submarine was conducting deep-diving tests 220 miles off of the coast of Cape Cod, Massachusetts, when it sank, taking the lives of all 129 personnel aboard. According to Sullivan, a series of malfunctions, including a flooding casualty in the engine room resulting from a piping failure in one of the salt-water systems, likely led Thresher to sink, ultimately exceeding her crush depth.

True to the cycle of safety culture that Sullivan spoke on, the sinking of Thresher was followed by widespread design and specification reviews. The Navy lacked a true doctrinal guide to submarine safety at that time and from the lessons of Thresher's loss, the Submarine Safety Program (SUBSAFE) was born.

Sullivan said during his lecture that there were other submarine disasters that contributed to what SUBSAFE is today, but he spoke mostly on Thresher, as the SUBSAFE origins date back to that year.

The Navy spent the next decade researching new safety methods to apply and issued the Submarine Material Certification Requirements Manual for the Submarine Safety Program in 1974—currently titled Submarine Safety (SUBSAFE) Requirements Manual. Elements of the SUBSAFE program include boundaries, design reviews and multiple certification requirements. There are many ways for a submarine to malfunction, so SUBSAFE focuses on submarine flooding and recovery from a flooding casualty.

"It doesn't cover electrical hazards or shipboard fires—flooding and flooding recovery, that's it," Sullivan said.

Part of the learning process includes assessing incidents of near misses. Because disasters are usually a result of multiple failures, it is as equally important to investigate the string in the close calls as it is with complete failures.

"Let's say you fix one thing that would have killed everybody, but you didn't look at the other four or five things that were in that chain," Sullivan said. "Near misses are important because you have to actually pick them apart and find the rest."

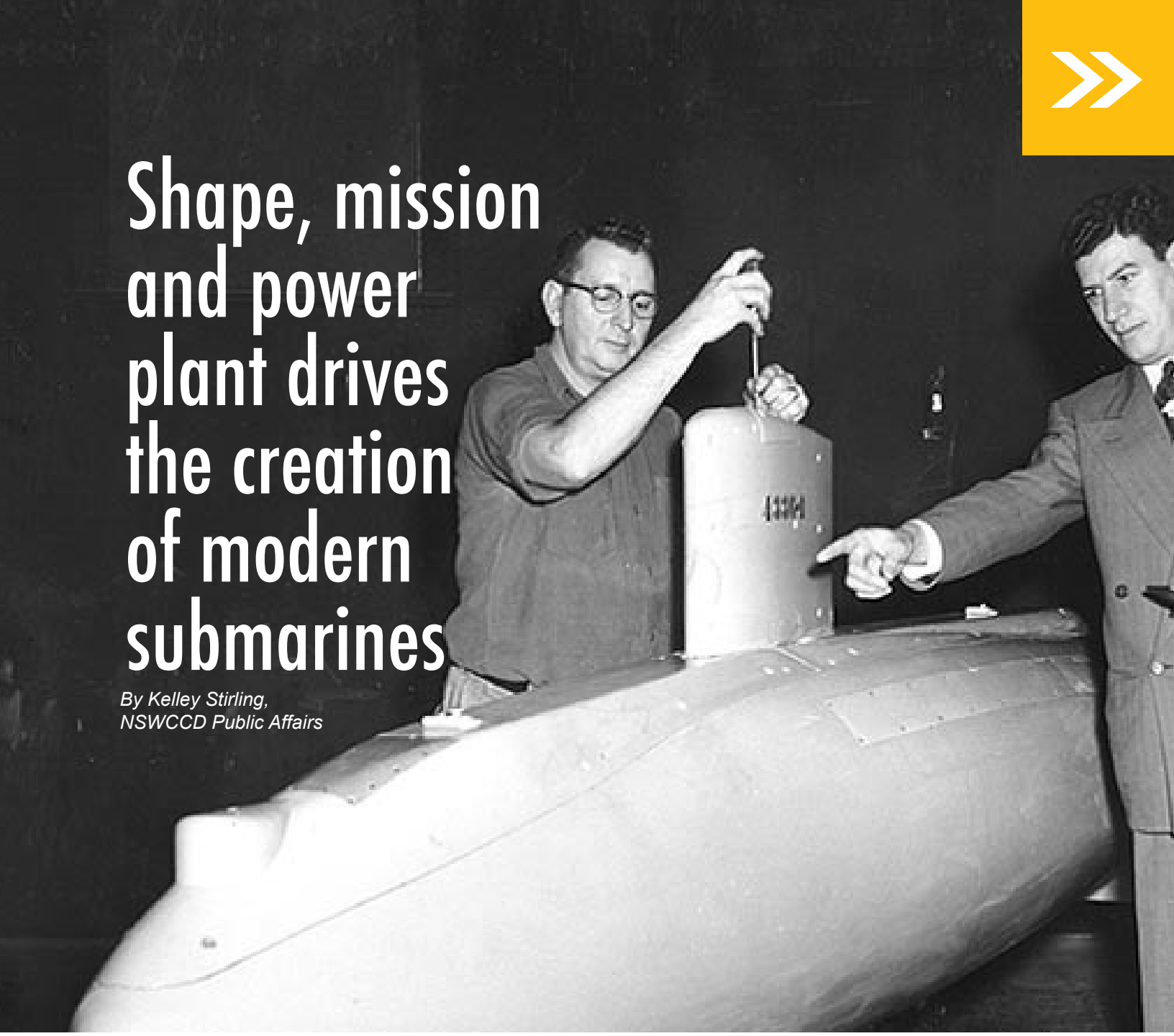
Rather than guaranteeing a perfect end result from unpacking non-lethal issues, Sullivan said there would be a much greater chance of a related issue happening in the future.

Equipment catastrophes are not limited to the Navy, as some of the most recognized examples Sullivan cited were not military related at all. When NASA lost lives in the explosions of two space shuttles, Challenger in 1986 and Columbia in 2003, flights were delayed just over two years both times. Each shuttle saw a series of delays prior to their launchings and the former of the two didn't even make it to space before tragedy struck.

Abiding by SUBSAFE standards has paid off for the Navy, as no SUBSAFE-certified submarine has been lost since the program began. Sullivan emphasized the need to always pay attention to details and avoid complacency with current successes for this streak to stay intact.

Shape, mission and power plant drives the creation of modern submarines

By Kelley Stirling, NSWCCD Public Affairs



The U.S. Navy submarine force is probably the most sophisticated technology of war in the world. How did it get there? In another historical presentation on April 15, his 12th at Naval Surface Warfare Center, Carderock Division, in West Bethesda, Maryland, James Harrison delved into what he thinks is the era that molded the current submarine force.

In "Sink or Swim: The Decade that Forged the Modern U.S. Submarine," Harrison explained how in the 1950s, the U.S. Navy made changes to the hull form, power plant and mission of the submarine.

"Coming out of World War II, the submarine force had a pretty good war, as all things went," said Harrison, director of Naval Sea Systems Command (NAVSEA) Combatant Ships Division. "The U.S. Navy built about 238 fleet boats during the war, and they were extremely successful against Japan, sinking nearly half of the ships sunk by the U.S. Navy."

Harrison said the primary mission of the submarines during the war was commerce interdiction and attrition. And since Japan is an island nation, he said it helped the war effort tremendously to wipe out the Japanese merchant marine fleet. Search and rescue was another mission, something Harrison said the Japanese didn't care as much about.

In terms of hull form, Harrison talked about three types that distinguished this time period of submarine development: the fleet boat, the Type XXI and the teardrop.

"The fleet boat was basically a surface ship that could submerge when it was convenient to do so, but really would prefer to operate more on the surface of the ocean," Harrison said.

Harrison said that by the end of the war, the Germans turned up with the Type XXI submarine, having the topside much

more streamlined than the fleet boats. In comparison to the fleet boats, which were almost twice as fast surfaced as they were submerged, the speed of the Type XXI hull form was roughly the same surfaced as submerged.

The United States got ahold of a few Type XXI submarines and started remaking the War World II fleet boats in what was called the Greater Underwater Propulsion Power Program, or GUPPY.

Not long after the war, the Navy was struggling to prove its worth, and with six submarines under construction at that time, the Navy was trying to figure out what mission the submarines would have.

"Now we are in the era of nuclear warfare," Harrison said. "And the thinking of the time was if you're not involved in nuclear warfare, you're kind of not involved."

Japan was no longer the adversary, and sinking Soviet merchant marine ships did not strike quite the blow to the U.S.S.R., which was also building its own fleet of Type XXI submarines.

With the advent of the Tang class, the U.S. Navy moved into the role of attack submarine. It was a Type XXI hull with a diesel engine, and torpedo tubes fore and aft.

"Probably one of the most famous submarines we built was the Nautilus," Harrison said. "As long as you're burning diesel or some kind of fossil fuel, in order to run your submarine, you have to be near the air so you can suck in enough air, or you have to get into technology that didn't become available until the 80s and 90s with the air-independent propulsion. With nuclear reactor, nuclear power, now you have all the power you need without having to exchange anything with the air. And that, of course, is what Nautilus is."

The speed of Nautilus was about the same both submerged and surfaced, and a bit faster than earlier submarines. As a Type XXI hull form, she carried torpedo tubes fore and aft. The ship was delivered in 1954 and on Jan. 17, 1955, Nautilus became the first ship anywhere in the world to get underway on nuclear power. She also became the first ship to pass under the ice at the North Pole.

Moving on from Nautilus, the Skate class became the first line production of nuclear submarines built in the U.S., with four delivered between 1957 and 1959. Still a Type XXI hull form, the Skate class was essentially a nuclear Tang class, again with torpedo tubes fore and aft.

While these Type XXI hull-form submarines were being built, the Navy was looking at the fundamental shape of the submarine, and in 1953, the Navy developed the Albacore class, the first teardrop hull form. Vice Adm. Charles Momsen wanted to build a submarine with this shape, and in order to speed the acquisition process, the Navy designed it as a "target" submarine with no weapons.

"To build this submarine, with a whole new hull form, it required a totally different test program," Harrison said, adding that although the design and testing work was done at Carderock, hull-form resistance testing was also done in a wind tunnel at Langley Air Force Base in Virginia.

With the tear-drop hull form, the submarines were built with one shaft, therefore the armed submarines with this hull form had the torpedo tubes only forward. And, the speed submerged became much faster than the surfaced speed. The Navy ultimately came to the end of the 1950s with the submarine of choice having a teardrop hull and nuclear power.

The Skipjack class became the first teardrop hull form, nuclear powered submarines, with the first commissioning in 1959. Typical of submarines with this hull form, they have only one screw and travel about twice as fast underwater as on the surface.

Again copying the Germans, the U.S. Navy developed the Regulus cruise missile, fitting both the Grayback and Halibut classes to carry the missile. As missile technology advanced, the guided-missile submarines became obsolete within four years of the first cruise missiles entering service.

"Now we have a new shape, new power and new missions, and now we are going to bring them altogether," Harrison said.

The George Washington class, which was the installment modification of the attack submarine Skipjack class, was the first set of ships built as nuclear-powered ballistic-missile submarines, carrying the Polaris ballistic missile, leading into the next decades of the modern and most sophisticated submarines in the world.

Supervisory Naval Architect Morton Gertler (right) directs Instrument Maker Carson Caudle in preparing a model of the submarine for further tests at the David Taylor Model Basin, Carderock, Md., on March 1, 1956. This new type of submarine hull design was selected from a systematic series of streamlined bodies developed by Gertler, who also supervised the thorough development testing program that resulted in the hull and appendages as they existed on the submarine Albacore. (Official U.S. Navy photo from the collections of the Naval History and Heritage Command)

Developing the Navy's flying boats with Eric Silberg

By Benjamin McKnight III, NSWCCD Public Affairs

May 8 marked the 100th anniversary of the beginning of the first transatlantic flight by air. In 1919, three Navy-developed aircraft, or flying boats, took off from Rockaway Naval Air Station in New York en route to Plymouth, England.

Naval Surface Warfare Center, Carderock Division's Eric Silberg, an aeronautical engineer with the Sea-Based Aviation and Aeronautical Branch, is well versed in the history of the plane that made this flight and the people behind it.

Silberg presented "Developing the Navy's NC Flying Boats: Transforming Aeronautical Engineering for the First Transatlantic Flight" on April 11 at the Rear Adm. David Taylor Naval Architecture Lecture series at Carderock's West Bethesda, Maryland, headquarters. He provided an in-depth historical lesson on the impact of these historic flying boats and how they have helped to shape current naval engineering, technology and aircraft.

Only 14 years after the Wright brothers proved the concept of powered flight, the world was in the midst of World War I and quickly learning how to use aircraft in combat. The United States, meanwhile, was struggling to combat German U-boats' ability to sink ships. Aircraft were capable of this mission, but the need to transport them via ship to Europe made them susceptible to U-boat attacks.

"Not only was this inefficient, but airplanes are by necessity low density and make poor use of limited cargo space," Silberg said. "These ships are being sunk by the very threat that some of these planes are intended to combat."

Rear Adm. David Taylor, at the time chief constructor of the Navy heading the Bureau of Construction and Repair, decided the best way to address this issue would be to build a large flying boat, a type of seaplane with a seaworthy hull for a fuselage so they could sustain themselves both in the air and on the water. He sent a memo to his assistant on Aug. 25, 1917, and within two months a prototype design was ready to be tested.

"It was gigantic by the day's standards, with proposed capabilities that were game changing. Of course, this was the first design and would undergo significant changes over the next year and a half," Silberg said.

Taylor, considered the founding father of Carderock Division, and four other aviation pioneers spearheaded the design and construction: Lt. Jerome Hunsaker, the first aeronautical engineering Ph.D. from Massachusetts Institute of Technology; Cmdr. Holden Richardson, the Navy's first engineering test pilot; Cmdr. George Westervelt, the designer of Boeing's first airplane; and Glenn Curtiss, one of the premier aircraft manufacturers at the time.

Officially called the NC (for Navy Curtiss) flying boat and nicknamed the Nancy, the prototypes underwent many rounds of testing in the Navy's Experimental Wind Tunnel and Experimental Model Basin to prepare for battle. These aircraft needed to be able to fly across the Atlantic Ocean while maintaining combat readiness, survivability, maintainability and the ability to deploy.

"Crossing the ocean was a means to an end, not it's reason for being," Silberg said. "It was a warplane and once it got to Europe, it needed to be ready to fight."

By 1919, the final product was a seaworthy aircraft with a wingspan nearly as long as the Navy's current anti-submarine vehicle, the P-8 Poseidon. However, by the time the NC flying boat was ready for battle, the war was over and the aircraft's primary mission ceased to exist. Determined to not let their efforts go to waste, Silberg said that the Navy decided to prove the capability of the aircraft's design by completing the world's first transatlantic crossing by air.

Crews of NC-1, NC-3 and NC-4 at Rockaway Beach, New York, in front of NC-3 in 1919. (Photo courtesy of Naval History and Heritage Command-NH 53385/Released)

To complete this trial, the Navy commissioned the NC Seaplane Division 1 and on May 8, 1919, NC-1, NC-3 and NC-4 took off from the Rockaway Naval Air Station in New York, planning to stop in Trepassev Bay, Newfoundland, before flying across the ocean for the transatlantic attempt. NC-4 faced immediate issues that delayed its arrival to Newfoundland and almost prevented it from continuing the voyage with the other flying boats. The division had a series of stops planned throughout the trip, including the Azores islands and the coast of Portugal, before the final stop of Plymouth, England.

"We take for granted the ability to navigate over long distances, but in 1919, new techniques had to be devised," Silberg said. "The NCs were equipped with new radio navigation gear and a line of 53 ships were positioned along the flight path shooting flares at night and making smoke during the day."

Even with the aforementioned precautions, the journey was a mixed bag of successes and failures. NC-4 made it to Plymouth after a total 52.5 hours of flying spread over 19 days. Unable to find the Azores, the NC-1 and NC-3 landed to conserve fuel and find their position but were damaged in the heavy seas. NC-1 was found by a passing freighter and while they tried it tow it in, it was lost at sea when the lines broke. NC-3 landed 200 miles from the nearest island and was forced to sail itself to port, surviving 30- to 40-foot waves and gale-force winds. Through the challenges, though, all crew members made it to the end of the journey safely.

"Not one crew member of the transatlantic flight was lost, and that is a testament to the design of their planes," Silberg said.

He referenced the latter two aircraft as "successful failures," as they proved the ruggedness of the NC design, even though they failed to achieve their desired goal or reaching Europe. These efforts and lessons from the first transatlantic attempt helped shape aviation's future.

On the day the NC flying boats departed Rockaway for Europe, one of the spectators was a young man named Juan Terry Trippe. He would go on to found Pan American World Airways and, 20 years after the flight of NC Seaplane Division 1, his company would complete the first commercial transatlantic flight along the same route taken in 1919.

"Closer to home, we have felt the impact and reaped the benefits here at Carderock," Silberg said. "Our basins and wind tunnels are direct descendants of the facilities at the Navy Yard critical to making the NC program a success, and our commitment to providing the Navy with world-beating technology traces back to our namesake."


CAPTAIN MARK VANDROFF
COMMANDING OFFICER
CARDEROCK DIVISION

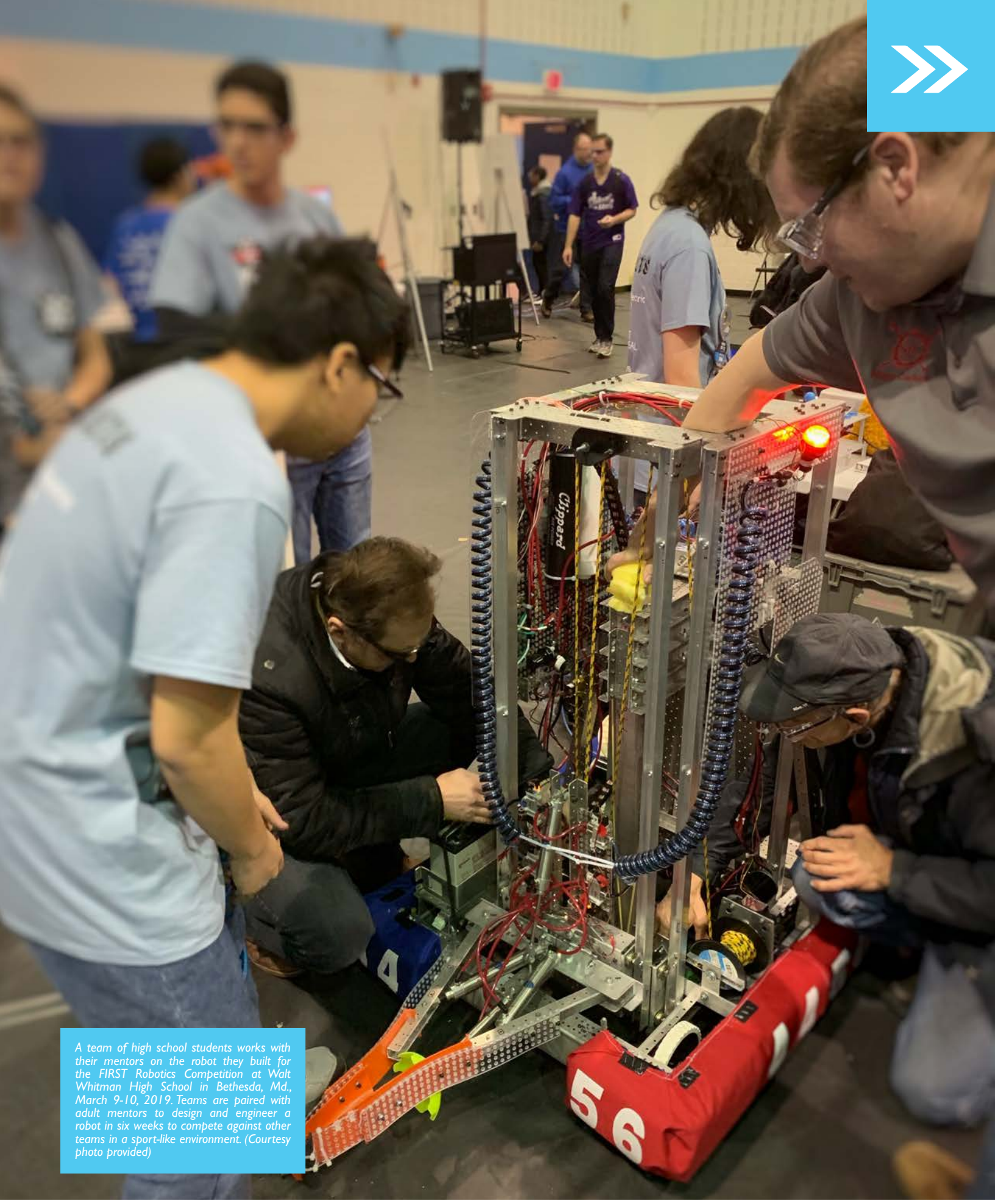
Chief of Staff Kathy Stanley receives Meritorious Civilian Service Award

Capt. Mark Vandroff, former commanding officer of Naval Surface Warfare Center, Carderock Division, presents Kathy Stanley (right), Carderock chief of staff with the Department of the Navy Meritorious Civilian Service Award on May 3, 2019, for her outstanding service from February 2011 to April 2019. Vandroff had just turned over command of the base to Capt. Cedric McNeal. Just a few contributions Stanley has made in this role include ensuring Carderock Division generated high-performing programs and professionals while remaining compliant; making significant contribution to the stand-up of the Philadelphia Division; and promoting employee growth. (U.S. Navy photo by Nicholas Brezzell/Released)

Earth Day celebration at Carderock

Capt. Mark Vandroff (right), commanding officer, and Capt. Cedric McNeal (left), prospective commanding officer, dig a hole alongside Adam Grossman, a wastewater and environmental engineer, on April 18, 2019, before planting a new tree at Naval Surface Warfare Center, Carderock Division's celebration of Earth Day in West Bethesda, Md. (U.S. Navy photo by Neubar Kamalian/Released)

Happenings
at Carderock



A team of high school students works with their mentors on the robot they built for the FIRST Robotics Competition at Walt Whitman High School in Bethesda, Md., March 9-10, 2019. Teams are paired with adult mentors to design and engineer a robot in six weeks to compete against other teams in a sport-like environment. (Courtesy photo provided)

Carderock employees judge FIRST Robotics Competition

By Jonathan Hopkins, NSWCCD Additive Manufacturing Project Office

Jonathan Hopkins (left) and Dr. John Barkyoumb from Naval Surface Warfare Center, Carderock Division participate as judges for the FIRST Robotics Competition at Walt Whitman High School in Bethesda, Md., March 9-10, 2019. (Courtesy photo provided)

For Inspiration and Recognition of Science and Technology (FIRST) has finished their 2019 Robotics Competition game and season. Each January at their kickoff event, a new, challenging robotics game is introduced. This year the theme was Destination: Deep Space, presented by Boeing Company. For the past 30 years, these competitions have combined the practical application of science and technology with the fun, intense energy and excitement of a championship-style sporting event.

Dr. John Barkyoumb, director of strategic relations at Naval Surface Warfare Center, Carderock Division, and Jonathan Hopkins, head of Carderock's Additive Manufacturing Project Office, served as judges for the FIRST Robotics competition at Walt Whitman High School in Bethesda, Maryland, in early March. Both Barkyoumb and Hopkins have been involved with FIRST for over 10 years. The event at Whitman High was the Chesapeake District competition where 38 teams from Virginia, Maryland and Washington, D.C., competed.

According to the FIRST Robotics website, this competition pairs high school students with adult mentors, primarily engineers and teachers, to design and build robots that compete against one another in a high-energy environment. This varsity "sport for the mind" combines the excitement of sport with the rigors of science and technology. Under strict rules, limited resources and time limits, teams of students are challenged to raise funds, design a team "brand," hone teamwork skills, and build and program robots to perform prescribed tasks against a field of competitors. It's as close to "real-world" engineering as a student can get.

The teams are given only six weeks to build their robots before boxing them up and shipping them to their respective district competition.

The competition serves as a celebration of the students' achievements. Judges evaluate teams based on their technical execution and core values.

For more information, visit this website: https://www.firstinspires.org/robotics/frc/game-and-season

Ballast Water Treatment Industry Day

By Brooke Marquardt, NSWCCD Pubic Affairs

Ballast water management is a key component of the Navy's plan to ensure environmental compliance and stewardship. A recent industry day hosted at Naval Surface Warfare Center, Carderock Division drew representatives from around the globe eager to network and hear experts from Carderock's Wastewater Management Branch, the Navy's source of knowledge and provider of environmental solutions for liquid waste treatment and management in marine applications.

"We wanted to engage industry, exchange ideas and answer questions," said Cindy Chen, the environmental engineer leading the project to design, fabricate and test the Navy's prototype ballast-water treatment system. "The Navy will leverage the information and industry feedback to refine our acquisition strategy."

The March 15 Industry Day at Carderock's West Bethesda, Maryland, headquarters was intended as a "pre-request for proposal" event. The day featured presentations from Holly Nestle, technical warrant holder for wet environmental systems and discharges; Stephan Verosto, head of the Wastewater Management Branch; Rita Schuh, ballast-water management technical area leader; Shelby O'Neill, Contracts Division representative; and Patrick Long, ballast-water management engineering manager.

Dr. John Barkyoumb, Carderock's director of strategic relations, gave opening remarks.

The Wastewater Management Branch is responsible for conducting research; development; testing and evaluation; system acquisition; and integration support, leading directly to deployment and implementation of wastewater-management solutions for the Navy surface fleet. These efforts include advanced development and integration of ballast water treatment systems and the demonstration and validation of equipment and systems specifically designed for shipboard constraints and requirements.

"We execute this role for the Navy and other maritime organizations by providing science and engineering expertise, including basic and applied research; specification development and acquisition support; design guidance; technology assessments; hands-on testing, evaluation, analysis, development, demonstration, validation and verification of marine systems and technologies; installation and integration guidance development; training; and support to life-cycle management of fielded systems and management processes," Verosto said.

The team at Carderock provides the expertise and unique facilities necessary to extend their capabilities from surface

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Rachel Jacobs, a chemical engineer in the Wastewater Management Branch at Naval Surface Warfare Center, Carderock Division, examines water from the Ballast Water Research Lab in West Bethesda, Md., on May 10, 2017. (U.S. Navy photo by Jacob Cirksena/Released)

ships and submarines to associated ship-to-shore activities and encompass strong partnerships and a solid network with the Navy fleet, waterfront activities, other U.S. military services, U.S. regulatory agencies, technical communities from foreign and domestic governments and militaries, industry, professional societies and academia. They are recognized as the technical leaders of shipboard liquid-waste science and engineering.

The Department of Defense (DOD) Manual 4715.06, Volume 3 issued in 2017 requires all future DOD surface vessels with a keel-laid date of Oct. 1, 2020, or after to manage ballast water. Ballast water treatment is one of the ballast water management options. Other options include the use of potable water as ballast water or offloading the ballast water to shore. For most Navy ships, potable water is not a feasible option, since the ballast water volume is in excess of millions of gallons. Generating this large volume of potable water within a relatively short ballasting period is not possible with the existing potable water systems. Offshore disposal will limit the ship's operational flexibility as the ship can only dispose of the ballast water in a port with treatment capabilities.

Ballast water treatment systems are an important compliance strategy for the Navy. As the Navy builds more new ships to achieve a 355-ship Navy, the branch's efforts will help the Navy develop systems to deliver the capability to meet the ship's operational requirements, while also ensuring compliance with ballast water discharge standards worldwide.

The branch's vision is to take their mission as part of the larger Shipboard Environmental Quality Program and Warfare Centers Enterprise through the delivery of high-quality, innovative, value-added products.

Carderock achieves OSHA's VPP Star Worksite recertification

By NSWCCD Safety Office

Naval Surface Warfare Center, Carderock Division in West Bethesda, Maryland, has been recertified by the Occupational Safety and Health Administration (OSHA) as a Voluntary Protection Programs (VPP) Star Worksite. The recognition is the highest safety award that the federal government can bestow on a worksite.

"Achieving VPP recertification is a significant achievement by the civilian employees at Carderock," said Wallace "Gator" Czapla, Carderock's VPP coordinator. "We're one of just over 2,300 recognized VPP worksites out of nearly 8 million worksites in the country to be recognized by OSHA. Our goal is to ensure that everyone goes home in the same condition as when they came to work at Carderock."

Carderock achieved its original VPP Star Worksite certification in October 2014. To achieve Star Worksite recertification, Carderock had to maintain injury and illness rates below the Bureau of Labor Industry's average for industry worksites conducting business similar to that of Carderock.

The division also continued to support the elements and sub-elements of VPP certification: leadership and employee involvement, worksite analysis, hazard prevention and control and safety and health training. Carderock submitted annual reports to OSHA describing how it is continuously improving upon the prior years. Carderock then hosted an audit team of OSHA compliance assistance specialists and special government employees from other VPP worksites to come on base and review its safety management system documents; conduct formal and informal interviews of the employees; and observe the cadre of scientists, engineers, chemists, technicians and support personnel performing their work throughout Carderock's facilities.

"Given the complexity of the research, engineering, and modeling work conducted here in West Bethesda, it might be easy to assume a facility with explosives, radiation, destructive testing and chemical laboratories that accepting that some injuries and illnesses will happen would be normal," Czapla said. "On the contrary, Carderock integrates safety into our work

processes making ensuring safety is equally as important as anything else we do. Achieving this prestigious safety award is a credit to the continued participation and support of safety and VPP by senior leadership, management and employees."

Developing and maintaining an effective safety management system requires leadership, commitment, safety committees and representatives throughout the site, especially considering the nature of the work conducted at Carderock.

"It has been my great honor to work alongside our Safety Office and all those who come to work at Carderock every day to ensure that this is a safe place to work," said Carderock Commanding Officer Capt. Mark Vandroff. "We have made safety in the workplace a top priority, and this continued recognition from OSHA just proves it. Carderock is proud to have been recognized, once again, as a Star Worksite."

Officials from Occupational Safety and Health Administration (OSHA) join Carderock Division as the West Bethesda, Maryland, site is recertified as a Voluntary Protection Programs (VPP) Star Worksite on April 23, 2019, in recognition of the command's stellar safety record. From left, Steve Ouimette, Carderock acting technical director; Capt. Mark Vandroff, Carderock commanding officer; W. "Gator" Czapla, Carderock VPP coordinator; Nadira Janack, OSHA Baltimore area office director; Richard Mendelson, OSHA regional administrator (Region III); Joe Barger, Carderock VPP team representative. (U.S. Navy photo by Nicholas Brezzell/Released)

Carderock employees recognized for Fleet Week support

Technical Director Larry Tarasek (left) and Commanding Officer Capt. Mark Vandroff (right) acknowledge the contribution several Naval Surface Warfare Center, Carderock Division employees made to 2018 Maryland Fleet Week on March 25, 2019. From left: Tarasek, Odean Cameron, Katie Ellis-Warfield, Mike Alban, Charlotte George, Angie Han, Ryan Donnelly and Vandroff. Not pictured are Jeffrey Campana, Anthony Hagler and Martin Sheehan. (U.S. Navy photo by Ryan Hanyok/Released)

Divers inspect basin for sub races

Dan Dozier (center), vice president of the Board of Directors for the Foundation for Underwater Research and Education (FURE), assists volunteer divers Mike Alban (left), director of operations for the Center for Innovation in Ship Design, and Ed Leibolt, a contractor in the Hydroacoustics and Propulsor Development Branch, as they inspect the David Taylor Model Basin on March 30, 2019, in preparation for the 15th International Human-Powered Submarine Races (ISR). Sponsored by FURE, ISR will take place at Naval Surface Warfare Center, Carderock Division in West Bethesda, Md., from June 24-28, 2019. (U.S. Navy photo by Charlotte George/Released)

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Samuel Wang (center), an eighth-grader from BASIS Independent McLean private school in McLean, Va., accepts the Carderock Math Contest first-place trophy on April 12, 2019, from Naval Surface Warfare Center, Carderock Division Technical Director Larry Tarasek (left) and Commanding Officer Capt. Mark Vandroff in West Bethesda, Md. (U.S. Navy photo by Nicholas Brezzell/Released)

Carderock's annual math contest in its 10th year

By Brooke Marquardt, NSWCCD Public Affairs

The Carderock Math Contest celebrated its 10th anniversary this year on April 12 at Naval Surface Warfare Center, Carderock Division in West Bethesda, Maryland. Over 200 students from across 25 schools in Maryland, Virginia and the District of Columbia came to compete for the trophy.

The contest, part of Carderock's science, technology, engineering and math (STEM) student outreach efforts, gave students an opportunity to showcase their talent for math in a series of individual and team competition in MATHCOUNTS-style tests. It began with the sprint and target rounds, sets of math problems each student answered alone, then a team round.

This year's keynote speaker was 2017 Miss USA and Miss DC Kára McCullough, a scientist at the United States Nuclear Regulatory Commission and the founder of the Science

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Exploration for Kids (SE4K). SE4K is an organization dedicated to promoting science, technology, engineering, arts and mathematic enrichment for students. The organization creates "fun-with-purpose" activities for every grade level through after-school programs, travel workshops and career readiness assessments.

McCullough said she became interested in math and science at a young age because it seemed to involve everything around her. Her mother encouraged her to pursue that interest and ultimately, she earned a degree in chemistry from South Carolina State University. She became a nuclear scientist at the Nuclear Regulatory Commission in downtown Washington, D.C., before winning the Miss USA 2017 title. When she spoke to these students, she emphasized the phrase, "Nothing in this world can take the place of persistence," and to have the courage to encourage other people.

The event also included various facility tours throughout the Warfare Center for students to gain a better understanding of what the engineers and scientists at Carderock do every day. Commanding Officer Capt. Mark Vandroff spoke to students about math in the real world of engineering and science.

Carderock scientists and engineers helped proctor and score the tests, led tours and spoke with the students about their careers. From there, volunteers took the students on tours of Carderock's facilities, with the Manufacturing, Knowledge and Education (MAKE) Lab, the David Taylor Model Basin and the Subsonic Wind Tunnel as highlights.

The top scorers from the morning competitions moved on to the main event, the countdown round, answering advanced math questions for speed in a bracket-style tournament until there were only four students competing for the top three prizes. The first-place winner was Samuel Wang from the BASIS Independent McLean private school in McLean, Virginia.

2017 Miss USA and Scientist Kára McCullough (right) demonstrates a fun math project during the Carderock Math Contest on April 12, 2019, at Naval Surface Warfare Center, Carderock Division in West Bethesda, Md. (U.S. Navy photo by Nicholas Brezzell/Released)


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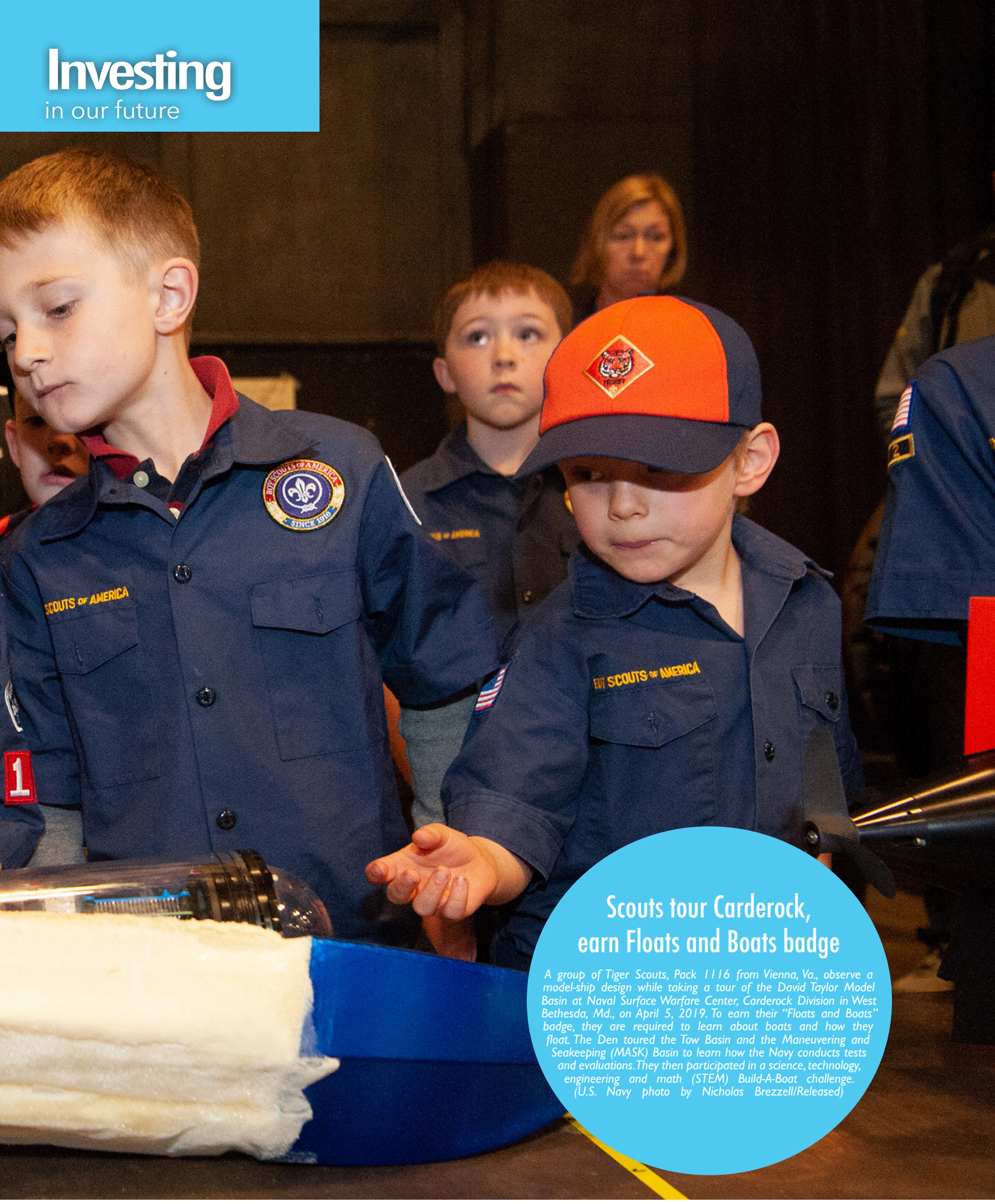

Scouts tour Carderock, earn Floats and Boats badge

A group of Tiger Scouts, Pack 1116 from Vienna, Va., observe a model-ship design while taking a tour of the David Taylor Model Basin at Naval Surface Warfare Center, Carderock Division in West Bethesda, Md., on April 5, 2019. To earn their "Floats and Boats" badge, they are required to learn about boats and how they float. The Den toured the Tow Basin and the Maneuvering and Seakeeping (MASK) Basin to learn how the Navy conducts tests and evaluations. They then participated in a science, technology, engineering and math (STEM) Build-A-Boat challenge. (U.S. Navy photo by Nicholas Brezzell/Released)

Carderock engineers help students build STEM cargo ships

By NSWCCD STEM and Outreach Program

Naval Surface Warfare Center, Carderock Division's Doug Griggs supported the Maryland Engineering Challenge—Cargo Ship Challenge event held annually at the Baltimore Museum of Industry.

This science, technology, engineering and math (STEM) challenge asked Maryland high school students to design and build a cargo ship that was capable of carrying 40 pounds of sugar around a course in the Baltimore Inner Harbor on April 14, adhering to constraints on length, draft and using a specified motor for propulsion.

Over the several months that preceded the competition, Griggs provided five teams with propellers that were designed by Thad Michael and 3D printed by Mark Melendez and Ryan Franke. Griggs taught the students in one team how to fiberglass, and a couple more teams how to solder, as well as provided design advice to all five teams at various points in the design and build process. Three teams of five who started the challenge had completed their cargo ships and presented them for competition.

"One aspect of this and similar challenges that seem to be often overlooked is the need to learn and apply project management skills to complete a project of this magnitude," Griggs said. "Challenges like this afford an opportunity to teach these skills, and in future years the challenge materials should include some more specific project-management guidance, perhaps with some intermediate goals like; final-design complete, hull-construction complete, control and propulsion system test and in-water testing."

Of the Maryland teams that did complete their cargo ship, one was from Poolesville High School in Montgomery County (the Night Owls) and two teams from Bel Air High in Harford County (the Engineers and the Belarians). The students submitted written reports and provided an oral report, as well as answered questions by the head judge, Paul Wiedorn, a Navy veteran and teacher in Carrol County schools.

The teams then launched their cargo ship, loaded the 40 pounds of sugar and ran the prescribed course in Baltimore Harbor. Griggs recorded the time it took to transit the course and provided the data to Wiedorn for his scoring sheet.

Inspection and oral reports began at noon with the Bel Air High engineers. When all the teams completed the inspection and oral reports, Wiedorn sent them to the Downtown Sailing Center pier to check in with Griggs. The engineers efficiently loaded their ship and got underway directly. Their ship ran slowly, but took off after loading and completed the course with no casualties, earning them a bonus for reliability.

The next team up was the Belarians, also from Bel Air High. They loaded up and headed for the starting gate, but quickly realized that their rudder was jammed. They were able to recover the ship before it entered the course, and decided to unload the cargo and "drydock" their ship and address the root cause of the jam.

While the Belarians were hard at work problem solving, the Night Owls from Poolesville High launched and loaded their ship. They entered the course at sea speed, rounded the first buoy and ran the balance of the course flawlessly. The pilot even executed a decent mooring maneuver at the end of the run.

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in our future

The Poolesville Night Owls round the first turn during the Maryland Cargo Ship Challenge, a science, technology, engineering and math (STEM) event held in the Baltimore Inner Harbor each year. Engineers from Naval Surface Warfare Center, Carderock Division helped high school students with the process of building a boat that could support 40 pounds of sugar while navigating different obstacles in the harbor. (Photo provided by Carderock employee Doug Griggs/Released)

By the time that the Night Owls had completed the course, the Belarians finished repairing the rudder and re-launched. After re-loading cargo, they entered the course and this time navigated the course with authority, completing the loop in just under five minutes.

In the final results, the Night Owls took top honors, the Belarians were second and the Engineers were third, separated from the Belarians by a single point.

"The team learned so much from Carderock this year during their building process, inclding design, model building and final building," said Zeck Huang, a teacher at Poolesville High School. "At the beginning, we knew nothing about boat building. After they went through the building process, they are very comfortable to tackle projects in the future."

For the first time in memory, all of the ships that showed up to compete successfully completed the course and there was no need to use a rescue boat.

"It is evident that this challenge requires a significant amount of time and concentration to successfully complete it, more than most teams expect at the outset," Griggs said.

Deputy Corporate Communications Director Peter Congedo helps Gigi Ghatt hold a water balloon during activities at Naval Surface Warfare Center, Carderock Division's Bring Your Child to Work Day in West Bethesda, Md., April 25, 2019. She is the daughter of Dave Ghatt, in the Office of Counsel. (U.S. Navy photo by Edvin Hernandez/Released)

Children of Naval Surface Warfare Center, Carderock Division employees learned more about their parents' roles in supporting America's Navy at Bring Your Child to Work Day on April 25, 2019.

Approximately 165 children checked into Carderock's Maritime Technology Information Center in West Bethesda, Maryland, and received a Carderock "passport" containing four empty stamp boxes. Students acquired a stamp from subject-matter experts after visiting each of the four facilities available to tour: the Maneuvering and Seakeeping Basin (MASK), the David Taylor Model Basin, the Subsonic Wind Tunnel and the Additive Manufacturing Lab.

At the MASK, children participated on a hands-on activity that encouraged their science, technology, engineering and math (STEM) curiosity. Chief of Staff Kathy Stanley watched her grandsons, Trent and Brayden Thurston, operate the SeaPerch. While some children found it difficult to function, Trent Thurston had no problem understanding the technology in front of him.

"I do remote-control stuff all the time, especially with monster trucks, so I had an advantage," Thurston said. "It was cool, but I'm more excited to see the waves."

A wave demonstration after lunch was provided for children and their parents to showcase the type of waves engineers can create at Carderock.

STEM careers, Carderock's mission highlighted during Bring Your Child to Work Day

By Edvin Hernandez, NSWCCD Public Affairs

The next generation of mathematicians, scientists and engineers were excited to see the Additive Manufacturing Lab, which houses 3D printing, and were surprised by the shapes and structures that were able to be created. Before leaving the AM lab, children received a 3D puzzle that was produced by one of the 3D printers on display.

Emma Melendez, daughter of mechanical engineer Mark Melendez, said the Subsonic Wind Tunnel was her favorite facility to visit. She expressed her interest in science and explained why it was her favorite subject.

"I like science because I enjoy many parts of it like chemistry, engineering and experimenting," Melendez said. "With chemistry, I like mixing and trying new things. I bake with my mom often and sometimes we do some food science. I think my dad's job is pretty cool, but I want to become a geologist because I like to study rocks."

Melendez developed her interest in geology from the books she has read and said her favorite type of rocks are emeralds.

Outreach coordinator Rachel Luu said events like Bring Your Child to Work Day are beneficial for children.

"I see a lot of enjoyment from the kids operating our technology," Luu said. "I think it's a very good entry way and this is something you would encounter at a science fair. It's a nice concise overview of what you can do with basic engineering tools."

LEGO Robotics challenge

Students and their mentor from Earle B. Wood Middle School in Rockville, Maryland, work on a computer to program their robot during the LEGO Robotics competition at Naval Surface Warfare Center, Carderock Division on April 26, 2019. At the event in West Bethesda, Maryland, student teams built and programmed their own robots to compete against other local middle school teams from the District of Columbia, Virginia and Maryland area. (U.S. Navy photo by Harry Friedman/Released)

Navy showcases their work at the Pentagon for DOD Lab Day 2019

By Brooke Marquardt, NSWCCD Pubic Affairs

Engineers and scientists from Naval Surface Warfare Center, Carderock Division and from across the Navy arrived in the Pentagon's courtyard on April 25 to showcase their technology alongside other branches of the military at the Department of Defense (DOD) Lab Day. This year, the Lab Day showcased close to 80 different booths of innovative technology from the Navy, Army, Air Force, medical laboratories and STEM programs from across the country.

Carderock Division engineers Benjamin Gordon and Christopher Nunes from West Bethesda, Maryland, and naval architect Dr. Evan Lee and Ki Pak from Carderock's Combatant Craft Division in Virginia Beach, Virginia, primarily manned the Carderock booth, answering questions and discussing their work with anyone who stopped by.

Gordon and Nunes were showcasing their work on small-craft science and technologies and micro-unmanned vehicles (MicroUxVs). The current problem for small crafts is that the structural design methods for high-speed naval craft rely heavily on empiricism to ensure the design is robust. They claim that with the current methods, the risk of reducing the structure is not understood.

"A better physical understanding of the dynamic response of high-speed craft in seas would allow for increased structural optimization," they wrote.

Their team has already conducted the first-ever model test of a semi-planing hull instrumented to measure the structural response in waves.

The MicroUxVs project was initiated to construct and field low-cost unmanned vehicles accessible to researchers, engineers and programmers developing autonomy capabilities and exploring multi-platform behaviors, like counter and super swarm. Fiscal 2018 showed the vehicle's capability to be upgraded, reconfigured and used in diverse applications. In fiscal 2019, the vehicles will be applied to swarm research. This research is a collaboration between Carderock and the Naval Surface Warfare Center, Panama City Division and Naval Undersea Warfare Centers, Newport and Keyport Divisions.

Pak, the deputy program manager for the Stiletto Maritime Demonstration Program, manned the booth promoting the Combatant Craft Division's Stiletto program.

The Stiletto program is unique in the way that it is open to all, from small businesses to large industry and government and international partners. The program provides engineering assistance to integrate systems aboard the craft and develops and executes demonstration plans to achieve technical goals. Their mission is to conduct these tests to validate technical feasibility, explore operational value and reduce developmental risk. Built in 2005, the Stiletto program has provided the opportunity to demonstrate in realistic maritime environments.

Technologies and innovations were on display by other Navy entities, including interestingly named things like the Spider Sense and the Flying Squirrel software suite. The software suite was designed by the Naval Research Laboratory to

Christopher Nunes (right), an engineer from Naval Surface Warfare Center, Carderock Division, holds a model of a Micro Unmanned Vehicle (MicroUxVs) while discussing his group's research with fellow Carderock engineer Benjamin Gordon at the Department of Defense's Lab Day in the Pentagon courtyard, April 25, 2019. (U.S. Navy photo by Monica McCoy/Released)

provide real-time discovery, analysis and mapping of certain wireless networks. Flying Squirrel also provides real-time wireless discovery, post hoc analysis capabilities and integrated visualization and mapping. The other parts of this software suite are also named after other animals: Caribou, Flying Fox, MeerCAT and Orb-weaver.

The Spider Sense technology is being worked on at the Naval Information Warfare Center, Atlantic Division and performs what the name implies. It is a low-cost, battery-powered ad hoc wireless network of small form factor, modular, mission specific sensors designed for the fusion of expeditionary cyber, radio frequency and physical situational awareness.

For more information on DOD Lab Day, visit https://www.defense.gov/explore/story/Article/1828144/lab-day-highlights-dod-technology-innovations/.

WAVES

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