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MARITIME REPORTER AND ENGINEERING NEWS

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September 2018

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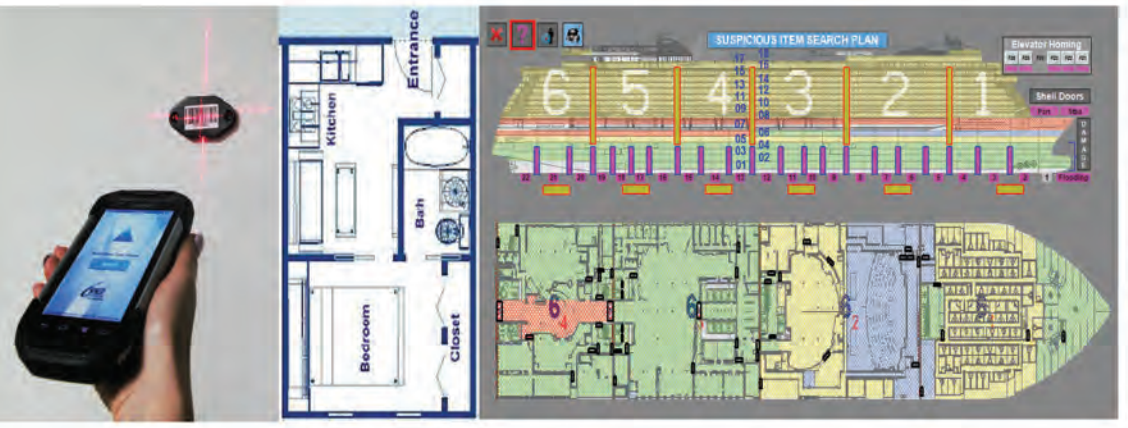

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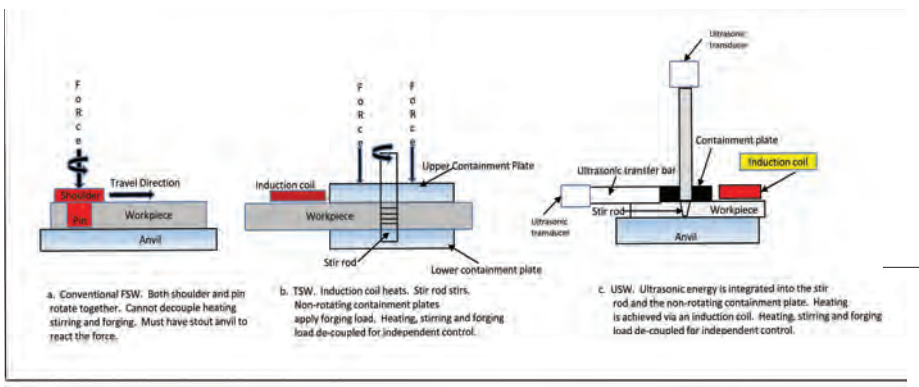

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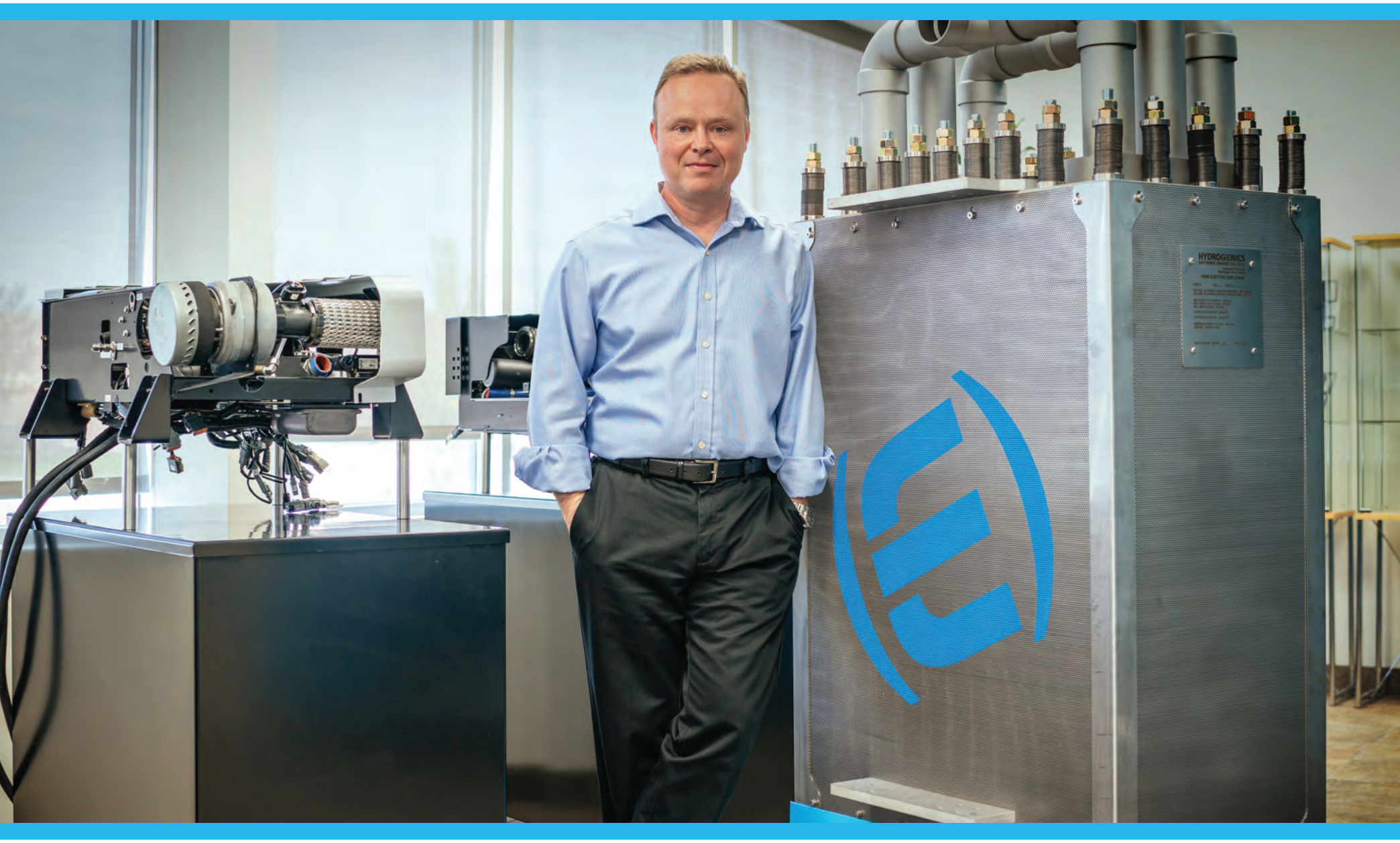

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Making the Connection

The marine industry's move toward digitalization ... big data ... the fourth industrial revolution ... call it what you will, is palpable. On writing this September's editorial I have just arrived in Hamburg, Germany for my 14th SMM exhibition, and nowhere else is it more clear that the this evolution is in full swing. When I started attending the SMM exhibition in 1992, the exhibition halls were filled with heavy machinery – mammoth diesels engines, gearboxes, propellers and bridge systems. Today, in 2018, there is a decided lack of heavy machinery, replaced with displays touting digital solutions.

As we all know, as we all have seen, digital promise comes with the potential for peril in the form of cyber breaches. This month starting on page 32, Patricia Keefe reports on ports' efforts to raise their collective cyber security game. But this is not just a port story, in fact far from it. In today's 24/7/365 world of 'always on, always connected' logistics and support, this cyber security issue transcends country or industry.

The 'connected' ship today is not simply a seamless connection between ship and shore, indeed it is much more. Today's ship is simply one node in the interconnected logistics web, and a disruption in one node can quickly and seamlessly spread globally, quickly. The best-known incident was the "notPetya" malware outbreak in October 2017, which struck A.P. Moller-Maersk's IT department, and through that, it's APM terminals at ports worldwide, including at Los Angeles, Long Beach and NY/Newark. The shutdown there and at other ports, and the ensuing cleanup of backlog, cost Maersk around $300 million.

While the Maersk incident was arguably the most publicized, trust that there are many more daily, around the globe, that threaten to disrupt the maritime industry and the global logistics chain. The challenge today is for operators globally to learn from past mistakes, while plotting for the future.

Looking at the traditional 'hardware' side of our business, I am very happy to present an article from Jeff Ding, starting on page 42 entitled 'NASA Welding Technologies: Could Revolutionize Workboat Fabrication' which discusses how solid-state welding processes being developed for NASA manufacturing programs could significantly reduce workboat fabrication costs. The author began his career at NASA's Marshall Space Flight Center in June, 1986, and he brought the friction stir welding (FSW) process to the NASA agency in 1995/1996 time frame when he secured a 14 ton Kearney and Trecker Horizontal boring mill and converted it to NASA's first FSW system. He completed his first FSW welds November 1996. He continued FSW development as well as ultrasonic stir weld (USW) and thermal stir weld (TSW) since 1996 and has authored 13 U.S. patents in solid state welding technology.

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THE COVER

Avoiding the Cyber Hack
Ports and ship owners alike are compelled to invest continuously in advanced cyber security, or pay the (high) price. Story starts on page 32.

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In this Edition


GE


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Tom Mulligan


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Photo of the Month

Nocturnal view to the bow of Cap San Antonio in Brazilian waters. Herbert Boettcher took this photo for Hamburg Süd when he travelled on the container ship Cap San Antonio from Europe to South America and back to Hamburg. Boettcher started with his worldwide long-time project Seamotion in 2004.

Boettcher is a German professional photographer working worldwide for shipping companies to create photos of merchant ships with his unique visual language. He has been working as a graduate designer for more than 20 years and has already received numerous awards for his applied and free photographic work.

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Blowin' in the Wind: Five Misconceptions of Wind Propulsion on Ships

As the collective maritime industry struggles to find a future proof propulsion system to meet ever stricter environmental emissions mandates from the IMO, serious talk and research is being paid to alternative technologies such as wind propulsion. As shipowners warily eye 2050 and the recent mandate to reduce greenhouse gas emissions by 50% by that date, it is commonly agreed that the technology to do so does not exist today. According to the IWSA there has been a significant trend developing around wind propulsion technologies over the last 12 months, driven by big numbers surrounding potential fuel savings: 10 to 30% fuel savings for retrofit installations and up to 50% in fuel savings for optimized new builds. And the discussion and trials are not simpy the remit of the laboratory, as several large, leading shipowners are putting the tech to the test on the high seas.

Norsepower's Rotorsails having recently been fitted to the Viking Grace and two 30m rotors on the 109,000dwt Maersk Pelican LR2 tanker. Peace Boat's Ecoship design, which will be the world's most sustainable cruise vessel, uses rigid sails as wind-assist on its 55,000 ton, 2,000 passenger vessel which will be built over the next few years. Gavin Allwright, Secretary General, IWSA said that these are the five leading misconceptions about wind propulsion on modern ships.

1. Wind Propulsion is an Old Tech: While it is true that the harnessing of wind for vessels is millennia old, the technologies that are being developed now have built on that wealth of knowledge, updated the systems, introduced new materials and automated the operations.

2. The New Rigs are Untested: MARIN is a global leader in ship design testing, and Rogier Eggers, senior project manager said, "MARIN has already built a firm understanding of the performance of wind (assisted) ship propulsion and is continuing to broaden and refine its prediction methods."

3. It's Only Suitable for Small Ships: "This is a common refrain and wholly inaccurate, yes wind propulsion systems work very well on smaller vessels and there should be much more development in the fishing, general cargo, small ferry sectors, however there are wind propulsion solutions for all sizes and types of vessels" said IWSA Allwright.

4. These Systems Need More Crew, More Training: Some of the smaller, more traditional sailing rigs do need more sailing knowledge and crew, however most of the commercial wind propulsion systems are automated, turnkey solutions that are optimized through weather analysis, routing and other operational parameters.

5. Wind Propulsion is Costly: Installing a wind propulsion system is not inherently costly, and the costs of manufacture and installation will come down as more rigs are installed. With an increasing choice of technologies, from lighter, easily installed rotors to larger more sub-stantial rigs, there are variable costs and returns.

Confidential Near-Miss Reporting

About the Author

Dennis L. Bryant is with Bryant's Maritime Consulting, and a regular contributor to Maritime Reporter & Engineering News as well as online at MaritimeProfessional.com. t: 1 352 692 5493
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As in most if not all industries, the maritime sector experiences many more near-misses than actual casualties. And yet, information regarding near-misses is seldom shared outside the particular company or vessel/facility involved. This is a needless waste of valuable learning opportunities.

The Federal Aviation Administration (FAA) established the first formal confidential near-miss reporting system in the federal government in 1975. The Aviation Safety Reporting System (ASRS) was transferred in 1976 to the National Aeronautics and Space Administration (NASA) for collection of information, deletion of identifying information, and publication.

Experience with the ASRS has clearly shown that, as expected, when organizations want to learn more about the occurrence of events, the best approach is simply to ask those involved. People are generally willing to share their knowledge of events if they are assured that their identities will be protected and there are no disciplinary or legal consequences. A properly constructed confidential, voluntary, non-punitive reporting system can be used by any person to safely share information. Confidential reporting systems have the means to answer the question 'why' – why a system failed, why a human erred. Incident and event data are complementary to the data gathered by other monitoring systems.

In an effort to increase the utilization and dissemination of such confidential information while making the process relatively uniform, Congress adopted the Confidential Information Protection and Statistical Efficiency Act of 2002 (CIPSEA), located at 44 U.S.C. §3501 note. Congress found that protecting the confidentiality interests of individuals or organizations who provide information under a pledge of confidentiality for federal statistical programs serves both the interests of the public and the needs of society. In addition, ensuring that information provided under a pledge of confidentiality for statistical purposes re-

Demark, Sweden, and Finland have national near-miss reporting systems for their marine industry. The Nautical Institute has operated the Mariners' Alerting and Reporting Scheme (MARS) since 1992.

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ceives protection is essential in continuing public cooperation in statistical programs. To that end, CIPSEA provides that an officer, employee, or agent of a federal agency acquiring information for exclusively statistical purposes who willfully discloses the information to a person or agency not entitled to receive it shall be guilty of a class E felony and imprisoned for not more than five years or fined not more than $250,000, or both.

The Office of Management and Budget (OMB) has published guidance to federal agencies on implementation of CIPSEA. Various federal agencies have since adopted programs under CIPSEA to collect, sanitize, and disseminate industry information relating to safety and related issues. Reports collected under CIPSEA are immune from legal process and may not be admitted into court. Those reports are also exempted from the Freedom of Information Act (FOIA). Information provided in such a report may not be disclosed in identifiable form for any nonstatistical purpose without the informed consent of the provider of the information. The reports are submitted directly to the authorized statistical agency, not to the agency that established the program and ultimately utilizes the aggregated and sanitized information.

Numerous federal agencies now administer programs that utilize confidential reporting systems authorized by CIPSEA. These agencies include, among others, the Department of Agriculture, the Department of Justice, the Department of Energy, and the Social Security Administration. The Department of Energy alone utilizes the CIPSEA confidential reporting program in 11 separate industry survey programs.

The Bureau of Safety and Environmental Enforcement (BSEE) recently instituted its own confidential safety reporting system, called SafeOCS. Personnel in the offshore oil and gas industry may submit confidential safety reports to the Department of Transportation (DOT) Bureau of Transportation Statistics (BTS), which performs the confidentiality tasks for BSEE that NASA performs for the FAA.

The SafeOCS confidential reporting system collects and analyzes data to advance safety in oil and gas operations on the outer continental shelf (OCS). It facilitates the capture of essential information about accident precursors and potential hazards associated with offshore operations, including risks related to pipeline safety and offshore transport.

Almost all oil and gas companies operating on the OCS have internal safety data reporting programs. However, due to legal and commercial concerns, these data were not being shared widely among stakeholders. SafeOCS provides a solution to these concerns by offering operators and employees a confidential method to share important equipment failure and safety data.

The aggregated data can be used to reduce the risk of major events, including loss of life or property and environmental harm.

Demark, Sweden, and Finland have national near-miss reporting systems for their marine industry. The Nautical Institute, an international group of maritime professionals headquartered in London, has operated the Mariners' Alerting and Reporting Scheme (MARS) since 1992. Selected near-miss incidents are published in their monthly Seaways magazine. Since 2003, the UK's Confidential Hazardous Incident Reporting Scheme (CHIRP) collects near-miss incident reports worldwide. It operates as a charitable trust and started out focused on the aviation sector. Findings and near-miss reports are published in the quarterly Feedback magazine.

In the early 1990s (prior to enactment of CIPSEA), the U.S. Coast Guard attempted to institute a maritime near-miss reporting program similar to the FAA ASRS program for aviation. The attempt ran into a stone wall when the Department of Justice (DOJ) strongly objected. The DOJ position was that once the federal government acquired information of potential wrongdoing there should be no self-imposed limits on use of that information. They conceded that they had not been particularly vigilant when the FAA instituted its ASRS program, but they opposed any further spread of the concept. That initial USCG effort for a near-miss reporting program ended there.

Now, though, Congress has spoken and strongly supports this type effort. It is time for the Coast Guard, with the support of the maritime industry, to institute a maritime near-miss reporting program. For years it has worked for the FAA and the aviation industry. It now works for numerous other federal agencies. Confidential near-miss reporting will work for the benefit of the Coast Guard and the maritime industry, but only if there is the wide support to restart the process.

Port of San Juan & Port Security Innovation

About the Author
Melissa Odegaard is the Marketing Director for S2 Global.

Thirty-six hours after Hurricane Maria hit Puerto Rico, the port of San Juan was back up and running, scanning the incoming relief cargo as it arrived. Now, nearly a year after the historic storm, San Juan remains one of the most secure and efficient ports in the world, scanning and adjudicating cargo shipments at an unprecedented speed, with wait times similar to pausing at a stop light. It was the first and only port in the Western Hemisphere to scan near-100% of incoming containerized cargo (bulk, un-containerized cargo is not scanned). At the forefront of collecting integrated port security data and exponentially increasing the quantity of cargo scanned, the Port of San Juan has revolutionized port security.

Photo: S2 Global

Security operations are often considered to be a cause of backed-up cargo traffic at any port. The inevitable delay that comes with manual customs inspection along with screening for narcotics, weapons, radiological substances, and other banned goods, creates a bottleneck that disrupts the port's operations. Regardless of the environment, pressures are mounting to move payload as quickly as possible through security screening while achieving cost efficiency. Yet increased volume, when combined with these pressures, leaves most ports successfully scanning less than 10% all incoming cargo.

The 2006 U.S. Safe Port Act required 100% screening of all inbound U.S. cargo containers. Moreover, the government of Puerto Rico desired, as an island, to effectively interdict the smuggling of guns, drugs and other contraband into Puerto Rico. In response to the Safe Port Act and the desire to reduce the flow of contraband onto the island, Puerto Rico implemented a regulation allowing for up to 100% scanning by Non-Intrusive Inspection (imaging) systems at the Port of San Juan. The time had come for a massive overhaul of the port's security system.

At the time of the Safe Port Act, the industry considered the rule an impossible feat; the Puerto Rico Ports Authority (PRPA), charged with port security, and the Hacienda, responsible for taxes and tariffs, were not prepared to scan 100% of the massive volume of goods passing through San Juan. The port is, after all, the busiest port in the Caribbean, with more than one million TEU's (20-foot equivalent) passing through its eight cargo terminals and 500,000 square feet in a given year. To get a program up and running quickly without crippling cargo traffic, the PRPA chose S2 Global to develop a soup-to-nuts scanning strategy with them that covered every step of the process from personnel to maintenance. Once operational, this fully integrated system scanned more containers in one month than had previously been scanned in an entire year.

By considering the specific needs of the port, S2 Global's operation was able to seamlessly integrate its new scanning system into the Puerto Rico customs process. In order to streamline the scanning process, containers are scanned at the truck-deployment checkpoint, rather than being manually inspected as they are unloaded from a boat. Before exiting the port, each truck drives through the Rapiscan Eagle M45, a flexible X-ray system that scans the contents of the container and truck axis in less than 60 seconds. This checkpoint's X-ray bursts

can reach through steel containers, producing an image with enough specificity to help an analyst verify the container's contents. The Port of San Juan was simultaneously pioneering the integration of logistics data and inspection images with adjudication and automated systems, such as access control. Logistics data arrives 24 hours ahead of the ship to the container reader and is matched up with the scan image at the checkpoint. Meanwhile, image analysts focus on adjudicating the contents to the manifest. The data is instantly shared with Puerto Rican law enforcement and compliance agencies. This centralized process allows for real-time discrepancy analysis, so that any anomalies can be flagged for additional inspection by authorities. The application of mobile scanning technology at the port, together with real-time data integration, minimizes interference with the flow of cargo traffic.

The turnkey operation developed true command and control in security operations that resulted in an even more efficiently managed process. The ultimate test of this management came in September of 2016, with the arrival of Hurricane Maria. As the hurricane wreaked havoc on the island, the port's supply chain was handicapped by the infrastructure bottleneck. Without a functioning scanning system, the rapidly arriving relief could not be deployed without ignoring safety concerns.

The port resumed operations at its checkpoints using generator power just 36 hours after the storm. With the fully integrated process back in place, S2 screened near-100% of the containerized cargo effectively and efficiently, and relief supplies reached the waiting people of Puerto Rico.

The security operations at the port of San Juan after Hurricane Maria show a breakthrough improvement in port security that has implications beyond times of crisis. The key is to emphasize the quality of data as much as the volume of goods moving through the security process. It is critical that analysts bring the big picture into sharper focus, pulling together relevant and valuable data from multiple sources to drive targeted security assessments. San Juan shows that such high-quality data can be collected and stored at rapid rates–five times faster than the industry average–and thus quality of scanning no longer comes at the cost of quantity of cargo scanned.

This reveals an important point about the future of port security: the synthesis of data generated by multiple sources and application-specific business rules provides an opportunity to automate manual processes and control specific flows. The availability of more granular information facilitates making crucial decisions, such as the most effective deployment of personnel and the appropriate use of automation. By accumulating information on one platform, data can be aggregated and analyzed, rather than checked once and forgotten. This approach supports enhanced collaboration, with data generated internally and from outside services creating an intelligence loop to share across teams and networks.

The Port of San Juan has become a case study in port security innovation. Every port, no matter how large or small, can implement near-100% of containerized cargo screening, time- and cost-efficiently, and all while accumulating valuable data on an integrated platform. As more ports follow suit in modernizing their approach to security, the result will be a more efficient and successful screening process shaped by decisions that are informed by integrated, rich data.

It's not where you are **It's where you should be** that matters

About the Author

Captain Paul Whyte MBE AFNI, Associate Master Mariner, LOC has 37 years' seagoing experience and 12 years' sea command. LOC is an independent marine and engineering consultancy and survey organization.

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Captain Whyte, a leading marine accident analyst at LOC Group, an independent marine and engineering consultancy which provides services to the shipping and offshore energy industries, explains how electronic data is making accident investigation clearer by providing irrefutable evidence.

"Fundamentally, situational awareness underpins everything we do", said Captain Whyte. "Whether that's crossing the road or driving ships at sea. We need to know where we are, what we're doing and where we are going. If a vessel has grounded or had a collision, then clearly the bridge crew must have lost their situational awareness."

He says that every deck officer should have a good working knowledge of the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS), and in using these 'rules of the [sea] road' every Master and Officer of the Watch (OOW) should observe the four 'A's at all times;

- **Aware;** the bridge team must be aware and maintain a proper lookout
- **Anticipation;** the vessel should travel at a safe speed giving space and time to assess if there's a risk of collision
- **Application;** the crew should know the COLREGS and particularly the risk of collision, and should follow the regulations
- **Action;** the crew must take positive and early action to avoid a collision.

However, when a collision or grounding does occur, Captain Whyte investigates the incident using electronic data, some of which is freely available, to establish the exact causes.

E-navigation is defined by the IMO as, "the harmonized collection, integration, exchange, presentation and analysis of

Photo: Shutterstock

marine information on board and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment."

It covers a number of ship and shore-based technologies that all significantly support and improve situational awareness and decision-making.

These include, but are not limited to, the Automatic Identification System (AIS), Electronic Chart Display and Information System (ECDIS), Integrated Bridge Systems/Integrated Navigation Systems (IBS/INS), Automatic Radar Plotting Aids (ARPA), Long Range Identification and Tracking (LRIT) systems, Vessel Traffic Service (VTS) and the Global Maritime Distress Safety System (GMDSS). All these sources produce data to determine situational awareness and that can also be analyzed in any accident investigation.

ECDIS is a digital navigational chart system which can be used instead of paper charts, making the navigator's workload easier with its automatic capabilities such as route planning, route monitoring, automatic ETA computation and electronic navigation chart updating.

The electronic chart displays the vessel's 'real-time' position, course and speed. It also carries out different complex functions to help improve the bridge crew's 'situational awareness' and can meld together radar imagery, ship information, chart activity and AIS information all into one view.

Using such tools, ECDIS can help to establish the best time-saving route planning within pre-defined 'safety corridors' although Captain Whyte cautions that a one-to-one check of the entire route from berth to berth must still be carried out. Furthermore, ECDIS can 'replay' the entire course navigated over the previous 12 hours, recording the entire voyage using 4-hourly time markers.

The International Maritime Organization (IMO) made the carriage of ECDIS mandatory under Safety of Life at Sea (SOLAS) Chapter V (Safety of Navigation) for most large vessels of 3,000 GT or more, on July 1, 2018. Looking ahead, Captain Whyte says that although only one third of the global fleet is currently required to use ECDIS, he envisages it spreading further and wider as shipowners see the benefits, regardless of vessel size.

The IMO made the carriage of AIS mandatory under SOLAS V for all vessels of 300 GT or more engaged on international voyages from December 31, 2004. AIS is publicly broadcast via a VHF transponder device with the primary function of improving ship-to-ship and controlled water space 'situational awareness', such as major ports and traffic pinch-points like the Dover and Singapore Straits. AIS transmits dynamic position and movement data, voyage related facts and static information such as vessel details designed to enhance water space management within the VHF horizon. An unintended consequence of AIS has been the ability of organizations to globally harvest AIS transmissions using low-earth orbiting satellites and terrestrial receivers and share it with companies like LOC, who use it for investigation purposes.

Using an electronic navigational chart within ECDIS, the OOW can monitor the safety corridor, safety contours, their own vessel GPS and its vector, any other vessels AIS and vector, the tide vectors and exploit the customizable menu.

Captain Whyte adds that another valuable source of navigation investigation data is the vessel's Voyage Data Recorder (VDR) – the 'black box' – which is an IMO requirement for passenger ships and vessels over 3,000 GT. VDR is a collection and storage device, recording on a continuous loop, and records the command and control inputs of the vessel. Software used for the reconstruction of an incident of the 'black box' and other electronic data is highly valued by investigators, lawyers and insurance interests.

A traditional casualty investigation might have involved; attending the casualty, interviewing the crew and taking statements, collecting contemporaneous (and digital) evidence, determining the 'angle of blow', establishing the 'type and location of damage' in groundings – understanding which way the vessel was going, providing documentation (including digital evidence) and engaging experts if there's no agreement and ultimately proceeding to trial.

Today, modern accident analysis means conducting an investigation using all the electronic evidence, validating any contemporaneous evidence and assessing any incontrovertible evidence which leads to an agreed set of facts and an understanding of the causation. This means that the parties involved can agree liability and costs, often without resorting to costly litigation and trial.

In addition, LOC has two further specialist tools which support its accident investigation analysis, by importing the electronic navigational data to reconstruct the grounding or collision scenario or modelling the 'what-if' options with the meteorological conditions at the time of the casualty.

The first is MADAS (Marine Accident Data Analysis Suite) which was developed by Avenca Ltd, for the U.K.'s Maritime Accident Investigation Bureau and the U.S. National Transport Safety Board. MADAS can display multiple vessel tracks, extracting and using the AIS and/or VDR data, it can use the audio track recordings of the crew at the bridge and the bridge wings during the incident. It can display different charts and overlays, and media including radar and CCTV – to show in 2-D the unfolding scenario, using precise vessel shapes, so the investigator can determine causation.

The second tool used by LOC for deciphering electronic intelligence is the 3-D program REMBRANT (Real-time Manoeuvring, Berthing and Training) which was developed by BMT, which enables the user to build a 3-D imagery of the 2-D analysis. This tool allows LOC to show a client how the incident looked from the bridge or birds-eye, whether by day or night, including modelling the 'what if' actions to avoid the incident.

Captain Whyte concludes that, "As I have already said, navigation is not about knowing where you are, but much more about knowing where you should not be, and still, too often ships end up where they should not be, sometimes with dangerous and hazardous consequences for all in the vicinity."

"But, by using electronic data and specialist tools we can now decipher the incontrovertible electronic evidence to understand exactly what happened, and if necessary, what actions would have prevented the incident."

Captain Whyte adds that, "By using the electronic data which is now available in any investigation, we can clearly see how the incident proceeded, and can then reach a conclusion much faster and cheaper for all those involved."

Selective Electroplating & Bringing Protection On Board

Derek Vanek, technical manager at SIFCO ASC looks into how the marine industry can decrease costs, and reduce downtime using selective plating methods as an alternative to disassembling components for repair.

About the Author
Derek Vanek is technical manager at SIFCO Applied Surface Concepts.

Day in, day out, marine equipment and the marine industry as a whole is subject to extreme conditions including salt water, high temperatures, wear, corrosion and fatigue. The problem which comes with these conditions is the length of downtime needed to repair key marine components and equipment.

Every second a vessel spends in the shipyard is one where it's not creating value or safeguarding national security. In the U.S. alone, investment in shipbuilding has grown steadily, with gross output in 2013 topping $28 billion. With these figures, it's crucial to minimize downtime.

Typical component problems and issues can include fretting or wear on bearings fits and flanges due to continuous vibration, extensive wear on bearing cap faces and saddle areas, corrosion on various components such as compressed air valves and parts exposed to sea water, steam cuts on high pressure turbine castings, worn Babbitt coatings on bearing shells, as well as out of tolerance or mismachined shafts, housings and bearings.

Traditional Plating

You may ask yourself why is an alternative plating method needed if the traditional method of tank plating is safe and still creates proven results?

Every second of downtime counts, as costs can mount up very quickly. The use of this traditional method can hinder the process and increase downtime further due to:

- The need to disassemble components.
- The time it takes to transport from shipyard to plating facility.
- The reinstallation ahead of re-entering service.

Tank plating involves the use of large tanks of preparatory and plating solutions and often requires extensive masking. The procedure is not portable, meaning the overall process, by nature, is rigid and not suited to components which need plating particularly fast.

Making Protection Portable

Selective plating is a well-established and reliable process which has already been written into shipbuilding specifications. It is a portable method of electroplating localized areas of metal surfaces for OEM components, permanent repairs and salvaging worn or mis-machined parts; providing a fast, efficient and targeted solution to corrosion, wear, galling, solderability and brazing. It is carried out by skilled technicians to repair or maintain critical parts.

The main benefit is portability. Only

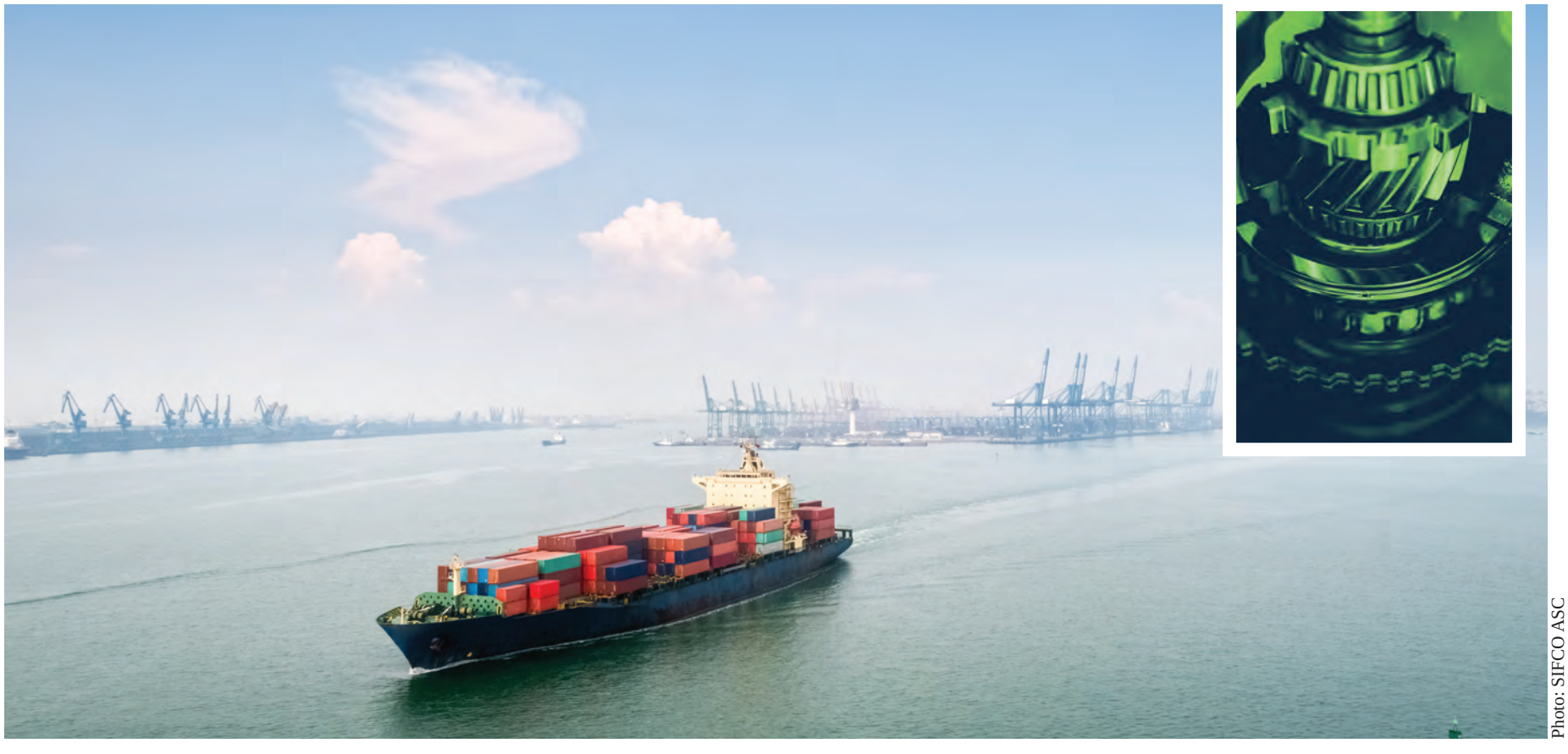


Photo: SIFCO ASC

Selective plating is a well-established process which has already been written into shipbuilding specifications. It is a portable method of electroplating localized areas of metal surfaces for OEM components, permanent repairs and salvaging worn or mis-machined parts

four elements are required: a power pack, plating tools, plating solutions and a trained operator.

Unlike tank plating, selective plating can be performed in situ – the part or component does not need to be removed and transported to an external site. It can be brought into the shipyard, aboard vessels, or anywhere it's needed to enhance or repair components, by any team member – certified technicians and engineers can take on the role after training, while the portable equipment facilitates machine shops at the point of repair.

The process not only exceeds the fundamental requirements of shipbuilding manufacturing, and repair and maintenance processes, it also provides a full circle of benefits, including quality, durability, cost saving, portability and time saving.

Take the SIFCO Process – the leading method of selective electroplating founded by SIFCO ASC. Carrying approvals from the American Bureau of Shipping, Mil-STD 2197(SH) and NAVSEA, the process uses significantly smaller volumes of plating solution than tank plating, using only the required material. There may be no need for disassembly or transportation, and minimal masking and post-machining; just a quick process that extends maintenance intervals and service life.

What's more, through the ASTM C633-79 Standard Test Method for Adhesion or Cohesive Strength of Flame Sprayed Coatings, the SIFCO Process also established that the cohesive strength of the deposit exceeds that of the bonding cement. For example, the minimum tensile strength value established (at the point of cement failure during testing) for Nickel High Speed is 22,803 kPa (11,200 psi) on a SAE 4130 steel base material. Additional qualitative tests, as described in AMS-QQ-N-290 were also conducted in which the plated areas were subjected to high stresses and strains. These results also showed excellent adhesion.

Protection in Port

Remanufacturing is an alternative option to replacing or re-engineering equipment, and is worth considering in the marine industry with bigger components which can be especially costly.

Sitting at the heart of the remanufacturing decision is the used part that is at the end of its service life. According to a study on 'Remanufacturing Inspection Models' by a PhD student at Exeter University, U.K. there are four main strategies applied in the decision making process for remanufacturing, each of which comes down to value and type of component. It states: "If cores [end of service life components] are relatively cheap, disposal is an effective way of increasing the reliability of the population as a whole. If cores are expensive they must be processed almost regardless of cost. In the case of low value cores there is often a new alternative that can be purchased in its place."

Remanufacturing of a component should be assessed on a case-by-case basis. Different processes, like selective plating, might be used in the remanufacturing process than were used in manufacturing the original equipment or part. Due to the high cost of marine equipment combined with the lead time required to purchase new equipment, remanufacturing with selective plating should always remain an option.

Mechanizing and Automating the Process

When a ship is in port, multiple repairs may be needed. Depending on the application, selective plating can be mechanized or fully-automated. Mechanizing the process minimizes the direct contact the operator has with the tooling and chemicals by using a computer program to control the rectifier performing all of the pretreatment and plating steps, providing consistent control of the process. While fully-automating the process removes the operator – and the variability – from the entire operation.

The main benefit of customized, fully-automated systems is that they require minimal need for operator intervention. Various pumps, flow systems, and cleaning agents, work together to change, catch, and circulate solution while a robotic arm holds, oscillates, and changes the anodes needed throughout an entire plating operation.

By automating the selective plating process using a programmable logic controller, operators can review data captured through the human-machine interface to determine if the operation was completed correctly. If any errors do occur, or quality standards are not met, operators can review the data and trace the error to its source and assign the appropriate corrective action, preventing the errors from being repeated – effectively improving traceability and repeatability within the process. Additionally, automation reduces the ergonomic risk to the operator, and also increases the available capacity by allowing skilled operators to focus on the core business processes.

Better on Board

Naval forces of the U.S., U.K. and Japan have all adopted the SIFCO Process to keep their vessels moving. Now, however, more commercial shipyards are opening up to selective plating for minimizing downtime, getting vessels back out there – and keeping them protected, when and where it's needed most.

MARINE FUELS & LUBES

Low Sulphur Fuel **Organizing the Switch**

About the Author

John LaRese is the Technical Advisor for ExxonMobil Marine Fuels. He has been with ExxonMobil for over 39 years. LaRese graduated from Maine Maritime Academy in 1979.

The International Maritime Organization's (IMO) decision to implement a 0.50% cap on sulphur emissions has created uncertainty among vessel operators. Questions are already being asked about how to comply with the changing emissions target, what types of fuels will be available and where. However, ensuring compliance isn't just about fuel selection; the actual switchover process from heavy fuel oil (HFO) to new, low-sulphur alternatives needs careful management. There are also implications for the selection of lubricants.

A series of important steps need to be taken before bunkering a low-sulphur fuel; vessel operators will therefore have to work out arrangements that meet the specific requirements of their vessels. Significantly, without careful preparation operators may jeopardize their sulphur compliance, which carries the risk of costly fines. They must also plan around fuel availability, given the possibility that some ports may be unable to meet the demand from the industry.

Tank Cleaning

Unless a vessel is fitted with a scrubber, operators will need to ensure that their fuel tanks do not contain high-sulphur HFO by the IMO deadline. Fuel tanks will probably retain sediment from the existing HFO, which is likely to contain those higher levels of sulphur. If this is not removed, there is the risk that the sulphur will contaminate the compliant fuel, pushing its sulphur content above the 0.50% limit. ExxonMobil expects that many compliant fuels entering the market will have a sulphur content very close to the 0.50% cap, so even very low levels of residual sulphur left in a fuel tank could tip a vessel over the IMO's compliance limit.

To minimize this risk, ExxonMobil recommends that vessel operators flush fuel tanks with a distillate-based product, which will help remove sludge deposits. This process may need to be repeated, depending on the amount of residue present. In some instances, tank bottoms may have to be manually cleaned. The fuel used to flush tanks could contain damaging levels of cat fines, which will require onboard treatment. Vessel operators must factor in how long these processes could take and keep in mind that any sludge removed from the tanks will need to be disposed of properly.

Operators should remember that the storage, handling and treatment of 0.50% sulphur fuels will involve bunkering fuels of a wider variety of viscosities, types and formulations than seen today. On board handling practices have to take into account likely changes in fuel types, including fuel segregation and routine compatibility testing.

Running Down Cylinder Oil Stocks

One benefit of the 0.50% sulphur cap is that vessels will be able to streamline their lubricant inventory as only one cylinder oil will be required. Vessels with scrubbers will continue to use HFO and high-BN oils, while those who choose to switch to low-sulphur fuels will need correspondingly low-BN formulations. These vessels must deplete their stocks of high-BN cylinder oils prior to the IMO deadline to avoid waste and disposal costs. To ensure compliance, ExxonMobil recommends that vessel operators work with suppliers who have adopted the latest ISO 8217:2017 fuel standard and have the proven technical expertise to help them navigate the upcoming changes.

LEGAL

Why opt for **Arbitration** in maritime?

Arbitration in the United Arab Emirates (UAE) has been evolving for over four decades. Initially, each Emirate had its own set of arbitration rules. This changed in 1992 when the government of the UAE issued the UAE's Civil Procedure Law. This law featured articles, which regulated arbitration procedures throughout the country. From that point onward, the UAE saw a significant increase in the number of arbitration centres including Dubai International Arbitration Center (DIAC), and Abu Dhabi Commercial Conciliation and Arbitration Center (ADCCAC) among others.

As part of the UAE's government vision in continuously strengthening the UAE's reputation and providing a stable legal framework to further boost investors' confidence, the UAE's Federal Law No. 6 for the year 2018 formally promulgates a new arbitration law, based on the UNCITRAL Model Law and evidences the UAE's ongoing commitment to being regarded as the international arbitration hub of choice in the Middle East region. As arbitration has evolved in the country, so has the UAE's

DIGITALIZATION

Evolving from **Data Noose** to **Data Intel**

Maritime newbuild projects, conversions and maintenance projects have at least one thing in common: millions are lost in search for the right information. About 30% of all work within these maritime projects consist of unnecessary searching, searching and more searching for data. The right data. This of course has a cause and luckily there is also a solution. First of all the cause. I visit many maritime companies that have heard of digital transformation, but are unable to give it any real interpretation. For most of them it remains a big cloud. Some companies do want to go further and start searching for software. They go to work diligently with often large, expensive software packages that seem to be a safe choice. However, these parties have little to no affinity with the maritime sector, while at the same time, the software is being used for highly complex newbuild projects, conversions and maintenance projects. In short: a recipe for disaster. It is often clear on shop floor that it should be different, but how?

Google: Data Waste

Even a search in Google, one of the largest data companies in the world, yields a huge data-waste. Informa-

maritime industry into a bustling global hub; providing a resourceful trading corridor connecting East and West. The flow of international trade relies heavily on the transport of goods by sea. The maritime business has weathered many political and economic challenges over the last few years, and yet, continues to take significant strides in technological and service advancement and improvement. Today, most maritime experts are looking at maximizing returns and cutting costs without impeding on quality, or efficiency. The strength of maritime is the willingness of key players from around the world to come together to encourage further innovation and development, specifically related to shipping.

This is where the UAE, especially Dubai has put together a Maritime Sector Strategy to encompass best practices for ship repairs, port facilities, bunkering, legal services and a whole range of maritime related facilities, positioning itself as a major contributor to the growth and development of the sector.

In response to the significant developments within the maritime community, and as part of the UAE government's vision, the establishment of the Dubai Maritime Cluster was inevitable with Emirates Maritime Arbitration Center (EMAC) as its arbitration arm, established by an Emiri decree in April 2016.

Due to this rapid growth in the sector, disputes are naturally expected to increase. Transport contracts and cases often require a complex and specialized set of laws and rules. Given the complexity of these disputes, alternative dispute resolution is a preferred way to litigation that can go on for years, with possible stages of appeal.

Arbitration provides many advantages in the resolution of maritime disputes too, allowing parties to choose arbitrators with sector knowledge or who are equipped with a specific understanding of the issue at hand. Maritime cases usually are quite technical in nature. Arbitration gives parties the option to circumvent lengthy court proceedings and the need for court appointed experts by agreeing to appoint someone as an arbitrator who has sufficient experience and expertise. Providing the arbitrator with the flexibility required to take a more proactive role in monitoring the progress of a case. In turn, this ensures that the matter is resolved in a timely and resource efficient manner. Allowing for the process, including the hearing(s), to be held privately and to remain confidential, which can be of great advantage since maritime cases are often of high value and once processed through courts, media attention is a possibility. Other advantages include the element of finality in judgement since there are very limited rights of review by local courts and the issuance of arbitral awards which are enforceable in foreign jurisdictions through the New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards ("New York Convention"). As a result, an arbitral award may be enforced in all the convention signatory countries.

The Author

Majid Obaid bin Bashir is Acting Chairman and Secretary General, EMAC.

About the Author

Geert Schouten is co-founder and Director of Shipbuilder Software. Shipbuilder is a data managing software during the life cycle of any maritime object.

tion that is of no use to you. What strikes me is that large data processing software companies copy this search system one-on-one. It's often searching for a needle in a haystack. All maritime companies have a gigantic database. For many this data is placed in Word, Excel, PDF and other non-suitable data processors. Searching for the right data is then a needlessly complex activity and how can you know for certain that your Word document is the latest version?

Real Maritime Digital Transformation

One search to get the data you need immediately. That's what you want! And the solution is so simple: let the computer rock! What could be better than a program with which all, often linked, data is directly available, in real time per project?

Data Intelligence

Together with my team, I have developed a smart data management program: Shipbuilder. We guarantee for 100% that the data structure of any maritime company fits into Shipbuilder. That makes us unique. For our customers, for example Damen and Ulstein, data suddenly becomes of enormous added value. Their data (regularly several terabytes) is available in real time and a search always gives the right information. And that is just the beginning.

Data Intelligence Knowledge Base: Develop Your Knowledge

In Shipbuilder, our 25 years of experience in the maritime sector is incorporated in a Data Intelligence Knowledge Base. This contains a wealth of basic information pre-programmed for complex maritime projects. At the same time, the Data Intelligence Knowledge Base will help your company unlock the knowledge while you're working. In this knowledgebase all explicit and implicit knowledge is retained for the future. A new colleague can start working with this knowledge immediately. Therefore all important knowledge remains in your company. It even helps Ulstein to develop at a rapid pace.

So will you keep searching for that needle in your gigantic data mountain, or will you develop with Shipbuilder?

Maritime Welfare Training …

… More Important than Ever

The shipping industry is facing unprecedented change. With topics such as new environmental regulations and the opportunities and challenges of digitalization dominating the conversation, seafarers' welfare has tended to be overlooked.

This trend is slowly changing as the industry continues to recognize the need to professionalize its approach to maritime welfare, but there is a long way to go. True, that there are model owners and operators within the industry who uphold the highest standards of welfare for their crew, but there is still plenty of work to be done to ensure uniformly high standards across the board.

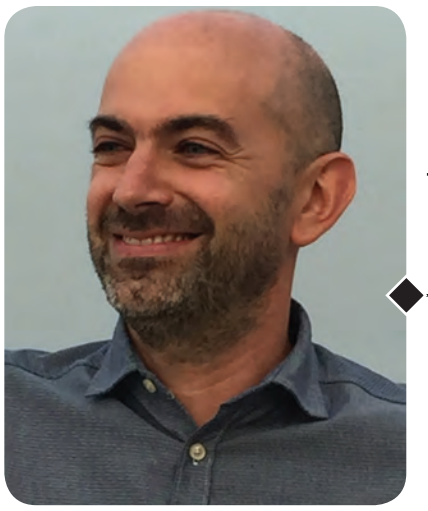
At least for the foreseeable future, seafaring will continue to be a physically and mentally demanding occupation in a dangerous environment. And without the dedication, commitment, and professionalism of seafarers, the whole fabric of global trade as we know it would fall apart.

This year, The International Maritime Organization (IMO) marked its annual Day of the Seafarer by highlighting the need for the industry to focus on the wellbeing of seafarers, particularly their mental health.

With stricter security controls in ports, endless inspections, and minimal opportunities for shore leave, it's no wonder that there is increasing awareness of the stresses and strains placed on seafarers and concerns for their mental, as well as physical well-being.

For maritime professionals engaging with seafarers, it's imperative to understand and appreciate the various issues affecting seafarers that can and

Photo: David Rider



About the Author

Luca Tommasi is Project Manager at ITF Seafarers' Trust

do have an impact on their overall wellbeing. One of the key issues highlighted and well publicized is fatigue, resulting from seafarers being expected to take on heavier workloads with less support, and to work longer hours with less time off – on board or on shore – to recuperate.

There are several dangers to this, most notably seafarers inadvertently placing themselves and their crew in immediate danger due to loss in concentration or perceived pressure to complete tasks quickly by taking shortcuts.

Clearly, we need to think not just about the physical health of seafarers, but also their mental health. This includes ensuring that they feel supported and encouraged to exercise and eat healthy, balanced meals – and this requires having access to healthy meals in the first place – as well as general health promotion. Ultimately, seafarers must feel empowered to have the necessary skills and knowledge to apply strategies to cope with day-to-day stresses they encounter. In addition, those working with seafarers, particularly those visiting ships, also need to understand their needs.

The reality is that seafarers exist in a complex legal environment where multiple jurisdictions of flags, ports, and their home countries sometimes fail to provide the protections enjoyed by citizens working ashore. As the industry continues to pay closer attention to the overall wellbeing of seafarers, it is worth noting that dealing with seafarer wellbeing requires a comprehensive and holistic approach that takes into consideration the roles and responsibilities of all stakeholders.

Seafarers remain heavily reliant on a vast network of shore-based counterparts when it comes to many aspects of their working lives, from ship owners to ship managers, flag state inspectors to port authorities and ship agents. Their decisions have a major impact on the conditions and wellbeing of seafarers, for better or worse. They are also supported by the extensive community of people providing maritime welfare services. Many of these individuals share a genuine commitment to the cause of maritime welfare. Indeed, for some, it is a vocation to which they have dedicated their careers and lives.

Maritime welfare touches on and is impacted by a wide range of issues, from the legal framework to an understanding of occupational health issues, including the physical, psychological, and social aspects of working at sea. Equally, the discipline of crew management today brings in a range of important considerations, including the evolving threats to safety and security, both in port and at sea.

Although training has historically been available in different aspects of maritime welfare, there has not yet been a training program that addresses all aspects, giving participants an all-encompassing 360-degree perspective on maritime welfare. However, this recently changed with the launch of MARI-WEL – the Professional Development Program in Maritime Welfare.

Created through collaboration between the ITF Seafarers' Trust and the World Maritime University (WMU), MARI-WEL is a new training program specifically designed to provide the skills and knowledge needed to support seafarer welfare. It is the first program of its kind to deliver a comprehensive and innovative distance learning course on topics that relate to maritime welfare. From the latest developments in IMO codes and conventions to the role and ethics of social intervention, the course covers all the bases.

The course is delivered by top experts in their field and is accredited by the WMU. In terms of a professional approach to maritime welfare training, we believe MARI-WEL is set to become the gold standard.

All employers with seafarer-facing personnel have a responsibility to equip their people with the knowledge and skills to do their jobs properly and professionally, which means understanding the welfare implications of the decisions that they take. We understand the pressures facing the shipping industry, ranging from the pressure of environmental regulations to the drive toward digitalization, but the human factor must not be overlooked. We must continue to collectively demand accountability on all issues relating to seafarer welfare. And crucially, we must continue to promote best practice and establish a professional standard in maritime welfare that can be upheld across our industry.

The MARI-WEL program opened its virtual doors on August 1 and we hope to see widespread take-up of the course.

To sign up, visit
http://mariwel.wmu.se

Cachet Covers & A boy's

BY EDWARD LUNDQUIST

Like many boys, Charles. F. "Bud" Kirby, Jr. loved ships. He had drawings, models, pictures, newspaper clippings, and scrapbooks. And, as his son, Don, recently learned, he had cachet covers of submarines.

Bud would send stamped envelopes to the Electric Boat Company that he had addressed to himself in Watertown, Mass. These envelopes would be stamped with a commemorative cachet and then appropriately canceled at Groton, Conn., where the EB shipyard was located, or on the ship if it had been commissioned.

Each ship has its own post office, and its own cancellation stamp. During the war ships used a more generic "U.S. Navy" cancellation for security reasons.

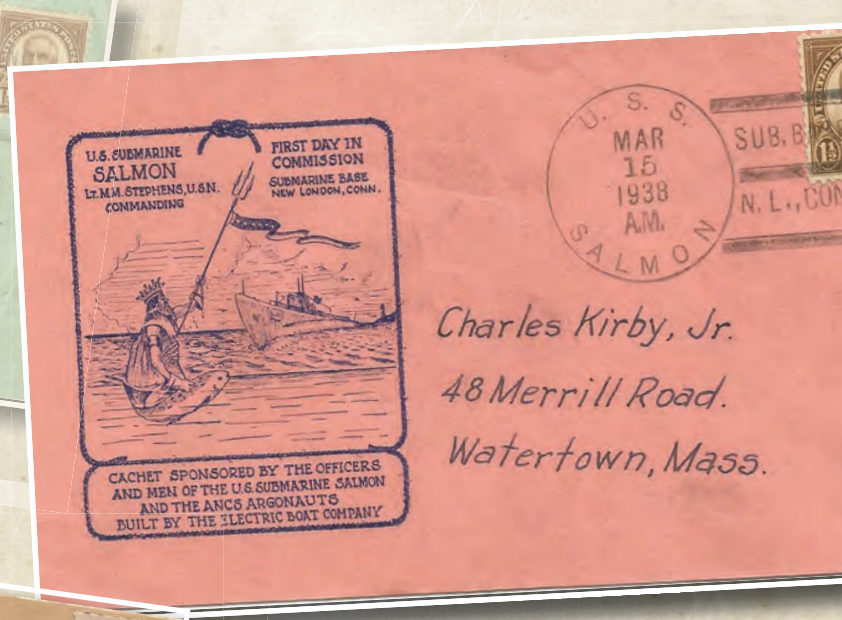
The hobby of collecting ship covers started in the 1930s. They were issued for events such as keel laying, launching and commissioning. Organizations such as the American Naval Cancellation Society (ANCS) and Universal Ship Cancellation Society (USCS) promoted the hobby. For Kirby, his collection is small, and not necessarily rare or especially valuable, but says a lot about his general fascination with ships.

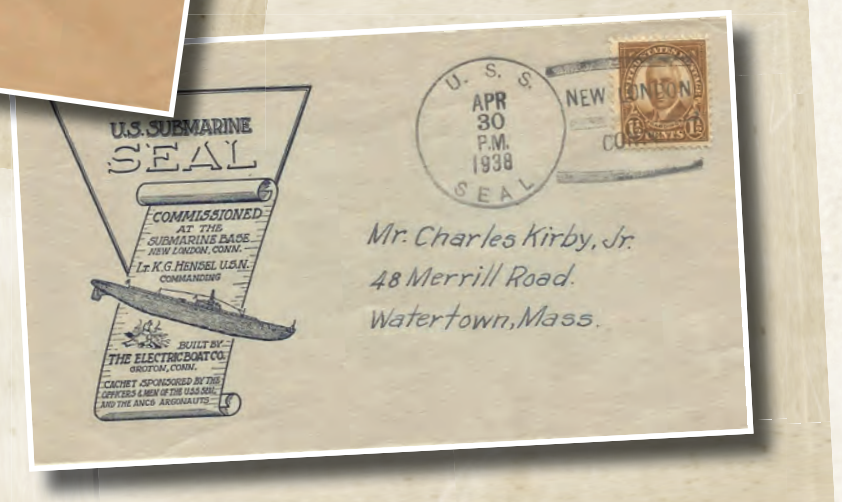
After high school, Kirby would spend time aboard real naval ships. His college education at Boston College was interrupted by the war. He enlisted in the Marine Corps and became a radio-tail gunner on SBD Dauntless dive bombers at Guadalcanal and the South Pacific. He spent time on aircraft carriers and transports. After the war he completed his education at UCLA and lived in California and Washington. He passed away in 2010.

"My dad kept these in the safe deposit box in an envelope labeled "Bud's personal momentos," said Don.

Kirby's collection are of pre-war submarines, but all of them would serve in the Pacific, like him. They were the submarines Salmon, Seal, Skipjack, Sargo, Seadragon and Sealion. They represent several different classes of submarines, but with very similar characteristics. The newest of the six boats, Sealion, was attacked and damaged in the Philippines on the opening day of the war with Japan, and scuttled soon after. But the other five served with distinction and survived the war.

The author is a retired U.S. Navy captain and Bud Kirby's nephew.





fascination with Ships

USS Salmon commissioning cover (cancellation March 15, 1938 aboard USS Salmon)
USS Salmon (SS-182) was the lead ship of her class of submarine

Builder:	Electric Boat Company, Groton, Connecticut
Laid down:	15 April 1936
Launched:	12 June 1937
Commissioned:	15 March 1938
Decommissioned:	24 September 1945
Struck:	11 October 1945
Fate:	Constructive loss due to battle damage; broken up for scrap, 1946

Salmon earned nine battle stars for World War II service in the Asiatic-Pacific area.

USS Seal commissioning cover (cancellation April 30, 1938 aboard USS Seal)
USS Seal (SS-183), a Salmon-class submarine

Builder:	Electric Boat Company, Groton, Connecticut
Laid down:	25 May 1936
Launched:	25 August 1937
Commissioned:	30 April 1938
Decommissioned:	15 November 1945
Struck:	1 May 1956
Fate:	Sold for scrap, 6 May 1957

Seal was awarded ten battle stars for her World War II service.

USS Sargo launching cover (cancellation July 6, 1938 at Groton, Conn.)
USS Sargo (SS-188), the lead ship of her class of submarine

Builder:	Electric Boat Company, Groton, Connecticut
Laid down:	12 May 1937
Launched:	6 June 1938
Commissioned:	7 February 1939
Decommissioned:	22 June 1946
Struck:	19 July 1946
Fate:	Sold for scrap, 19 May 1947

Sargo was awarded eight battle stars for her service in World War II.

USS Seadragon keel laying cover (cancellation April 18, 1938 at Groton, Conn.)
USS Seadragon (SS-194), a Sargo-class submarine,

Builder:	Electric Boat Company, Groton, Connecticut
Laid down:	18 April 1938
Launched:	21 April 1939
Commissioned:	23 October 1939
Decommissioned:	15 November 1945
Recommissioned:	8 February 1946
Decommissioned:	29 October 1946
Struck:	30 April 1948
Fate:	Sold for scrap, 2 July 1948

Seadragon earned 11 battle stars during World War II.

USS Sealion keel laying cover (cancellation June 30, 1938 aboard USS Skipjack)
USS Sealion (SS-195), a Sargo-class submarine

Builder:	General Dynamics Electric Boat, Groton, Connecticut
Laid down:	30 June 1938
Launched:	25 May 1939
Commissioned:	27 November 1939
Fate:	Scuttled at Cavite on 25 December 1941 after being damaged by Japanese aircraft on 10 December 1941

Norwegian Marine Tech
In the Driver's Seat

Earlier this summer Maritime Reporter ventured the Ålesund/Sunnmøre area of western Norway for an update on marine technologies from the area. Visits included GCE Blue Maritime Cluster in Møre in Norway as well as Inmarsat, VARD Group, Ulstein Group, Brunvoll, Ulmatec, Jets, ABB Marine & Ports, Fostech AS

BY TOM MULLIGAN

Photo: Tom Mulligan

Shipbuilding at VARD
The company recently won a contract for a new luxury cruise vessel from German operator Hapag-Lloyd.

The Internet of Things

An initial 'port of call' was the local Norwegian offices of Inmarsat, a specialist in the provision of global mobile satellite communication services. The company's presentation focused on its Inmarsat Research Program, now in its second year, which looks at understanding the ways the Internet of Things (IoT) is affecting the global supply chain and the way in which organizations in a range of industry sectors, including maritime, operate. In a survey commissioned by the company in May of this year, 750 respondents, including 139 from the maritime sector, were asked about their use of, attitude to and predictions for IoT within their organization and industry, including about their IoT development in six key areas: adoption, security, connectivity and IoT technologies, skills, data, and investment. In terms of adoption, the survey concluded that the maritime sector included a high number of companies it classed as 'leaders' but also a significant number of 'laggards'. Seventy percent of maritime respondents said that cutting insurance premiums was one of the most important drivers of the adoption of IoT-based applications, however it was also found that the sector was considerably lacking in the skills required for IoT adoption. Forty-two percent of respondents believed that their organization would benefit from additional IoT skills. Regarding security, most maritime respondents were classed as 'starters', with 87% believing that their data-handling processes could be improved. Similarly, the vast majority were classed as starters in IoT data usage, 43% of them saying that they were using or would use such data to improve health and safety standards. Most respondents were adapting well to the connectivity requirements of IoT, with very few laggards, a considerable number of starters and progressives, and a significant number of leaders, 51% ranking satellite connectivity as 'number one' by usage. Finally, most of the maritime respondents were classed either as starters or progressives when it came to IoT investment, with their average predicted cost savings achieved through the adoption of IoT solutions expected to be about 14%.

VARD: Luxury Expedition Cruise Deal

Next it was off to visit Norwegian shipbuilder VARD. The company recently secured a contract for a luxury expedition cruise vessel for cruise company Hapag-Lloyd Cruises. The new vessel will join the company's HANSEATIC series, together with the two vessels that VARD already has under construction for the German company. The vessels are specially designed for cruises in polar regions in the Arctic and Antarctica, as well as operations in warm-water destinations such as the Amazon.

The new vessel will have a gross weight of about 16,000 tons, a length of about 139 meters and width of 22 meters and it will have seven passenger decks with accommodation for 230 passengers in 120 cabins and suites. Similar to its sister vessels, the ship will have high-standard facilities, including a water sports marina and modern spa and fitness areas. Delivery of the new vessel is scheduled from Vard Langsten in Norway in 2Q 2021. The hull will be built by VARD in Romania.

More Shipbuilding

Ulstein Group's headquarters at Ulsteinvik was the venue for a series of presentations by the company and its suppliers. Ulstein has signed a shipbuilding contract with a German company, Bernhard Schulte, for an SOV of the ULSTEIN SX195 design type developed by Ulstein Design & Solutions. The vessel will support the maintenance work of GE Renewable Energy at offshore wind farm Merkur Offshore in Germany. The project was developed in cooperation with Bernhard Schulte affiliate WINDEA Offshore.

The SX195 design of the vessel has been modified to fulfil GE Renewable Energy's tender requirements and the shipowner's particular mission equipment needs. It has a large, centrally-positioned 'walk to work motion' compensated gangway and elevator tower for personnel and cargo transfers and a 3D compensated crane capable of two-ton cargo lifts is included. The optimized onboard logistics includes large storage capacities, of which half is under roof in a controlled environment, and a step-less approach to offshore installations. The vessel is also equipped with a fuel-efficient drive system that includes a battery-solution from Ulstein. With all main equipment and operations in the aft ship, the vessel will naturally operate astern while in-field in areas such as operation and maintenance or construction support, avoiding slamming, noise or vibrations caused by waves, especially in challenging weather and sea conditions.

Marine Power

Propulsion, positioning and maneuvering equipment specialist company Brunvoll is one of Ulstein Group's main suppliers and its Brunvoll Volda subsidiary recently delivered an extensive propulsion and maneuvering equipment package to Ulstein Group company Ulstein Verft for Color Line Marine's new hybrid Ro-Pax ferry, which is currently known as Color Hybrid.

The hybrid propulsion system is a twin-screw gearbox and cp-propeller system with PTI/PTO for a combined electric motor/generator designed for a combination of diesel-mechanical, electric- or battery operational modes. In addition, the rudder is integrated with the propeller and hull for optimal fuel efficiency and the thruster package consists of two FPP tunnel thrusters and an RDT permanent magnet driven tunnel thruster. The delivery also contains control systems for propulsion, positioning and maneuvering.

Waste Energy Recovery

Ulmatec (Ulstein Marine Technology AS), a descendant of Ulstein Mek Verksted, the origin of Ulstein Group), operates a number of subsidiaries, including waste energy recovery specialist Ulmatec Pyro. The company has recently been developing systems for use in exploration vessels and works on the premise that the majority of the heat lost from a combustion engine can be captured and reused for a number of purposes including the heating of accommodation, sanitary hot water, heating swimming pools, producing fresh water, tank heating, HFO pre-heating, tank washing, de-icing and the pre-heating of engines in standby mode. In addition, new technologies are

Photo: Tom Mulligan

Practicing offshore support operations at the **Offshore Simulator Center:** optimizing procedures in this way ensures effective, efficient and safe operations in the field.

being developed for generating electricity from waste heat and for the cooling of accommodation: these developments offer considerable potential fuel savings for exploration cruise vessels, which can have an average heat demand of about 800 kW when operating in cold climates.

Ultra-low-water-consumption Sanitary System

Ulstein Group supplier Jets has launched its new Jets Edge vacuum sanitary system. Sanitary systems on ships worldwide were revolutionized when the company launched the first Vacuumarator pump onto the market in 1989, as this was a much more compact, efficient and reliable piece of technology than any previous system. Jets further cemented its position as a leading vacuum sanitary systems supplier with another significant milestone in 2000 when the modern version of the Vacuumarator pump was released. Its benefits included in-line vacuum generation, no foaming, a fully integrated macerator, no need for a collecting tank, a more compact size than before, simple and flexible installation, easy retrofits, and very low energy consumption. Now, by refining the technology, Jets is able to present the company's newest Vacuumarator pump, Jets Edge.

The system has very low water consumption, thereby meeting growing concerns about water shortages worldwide. In addition, testing has shown that the Jets Edge is more energy efficient than its predecessors, making it an attractive technology from an environmental point of view.

The Jets Edge comes in two versions: the EdgeM01 and the EdgeM01-D, which is especially designed to handle larger volumes of fluids. The Jets Edge can be used in ships, yachts, cabins, and trains: anywhere a compact, high-capacity and low-energy sanitary system using a minimum of water is needed.

Power, Automation & Propulsion

ABB Marine and Ports has a global presence, employing 1,800 marine and 300 port professionals at 35 service stations in 23 countries worldwide. The main marine markets of the business include the cruise and ferry, offshore, ice-going, cargo and specialized vessel sectors, where it supplies propulsion products, electrical systems, automation and software, and integrated operations, while for ports it serves bulk and container terminals with automated bulk and container handling and provides electrification and IT as part of its port infrastructure and shore-to-ship power service.

ABB will deliver a comprehensive package of power, automation and propulsion solutions for a new Linblad Expeditions Holdings polar expedition vessel being built by Ulstein Verft, including its main propulsion units, tunnel thrusters, distribution transformers, a drive system and switchboards. In addition, German shipbuilder MV WERFTEN has ordered ABB propulsion, automation and marine software for five new vessels for Genting Group cruise operators Crystal Cruises and Star Cruises, all five featuring ABB propulsion, with three Crystal Cruises ships being powered by two Azipod D units each, and two Star Cruises 'Global Class' ships being powered by three Azipod XO thrusters each. All five ships will have an ABB electric power plant and automated system installed, as well as the OCTOPUS ABB Ability Marine Advisory System.

In another contract, a Ritz-Carlton Yacht Collection vessel to be built at H.J. Astilleros Barreras in Spain and set to sail in 2019 will be provided with Azipod DO propulsion systems, generators, a main switchboard, bow thruster motors and starters, and an ABB Integrated Automation System.

The world's first luxury-cruise icebreaker ship, Le Ponant Icebreaker ICEBREAKER, which will be built at the Vard Søviknes yard in Norway and is scheduled to set sail in 2021, will be provided with ABB generators, switchboard, propulsion transformer, propulsion units, tunnel thrusters, batteries and remote control system.

Augmented/Mixed Reality & Maritime Ops

Fostech AS was established in October, 2015 and has office locations in Fosnavaag and Ålesund. The company develops augmented and mixed reality solutions with the goal of adding value for maritime customers by improving quality, safety, productivity and customer profit. In a fascinating session, company CEO Harvard Notøy demonstrated how these technologies work, with a specialized viewing system that shows a 3D image of, for example, a ship or a ship's engine, which the viewer can move around by physically moving around the room while at the same time being able to expand the image for a more in-depth view by clicking his fingers. Such a system can be used to assist maintenance staff, for example, and includes menus that instruct mechanics and engineers on how to successfully carry out maintenance operations. The technology is adaptable for a wide variety of other applications (for example, medical surgery) and is set to become the industry standard for guiding the performance of a wide range of industrial operational procedures.

For further information visit the following websites:

www.bluemaritimecluster.no
www.inmarsat.com
www.vard.com
www.ulstein.com
www.brunvoll.no
www.ulmatec.no
www.jetsgroup.com
https://new.abb.com
www.fostech.no

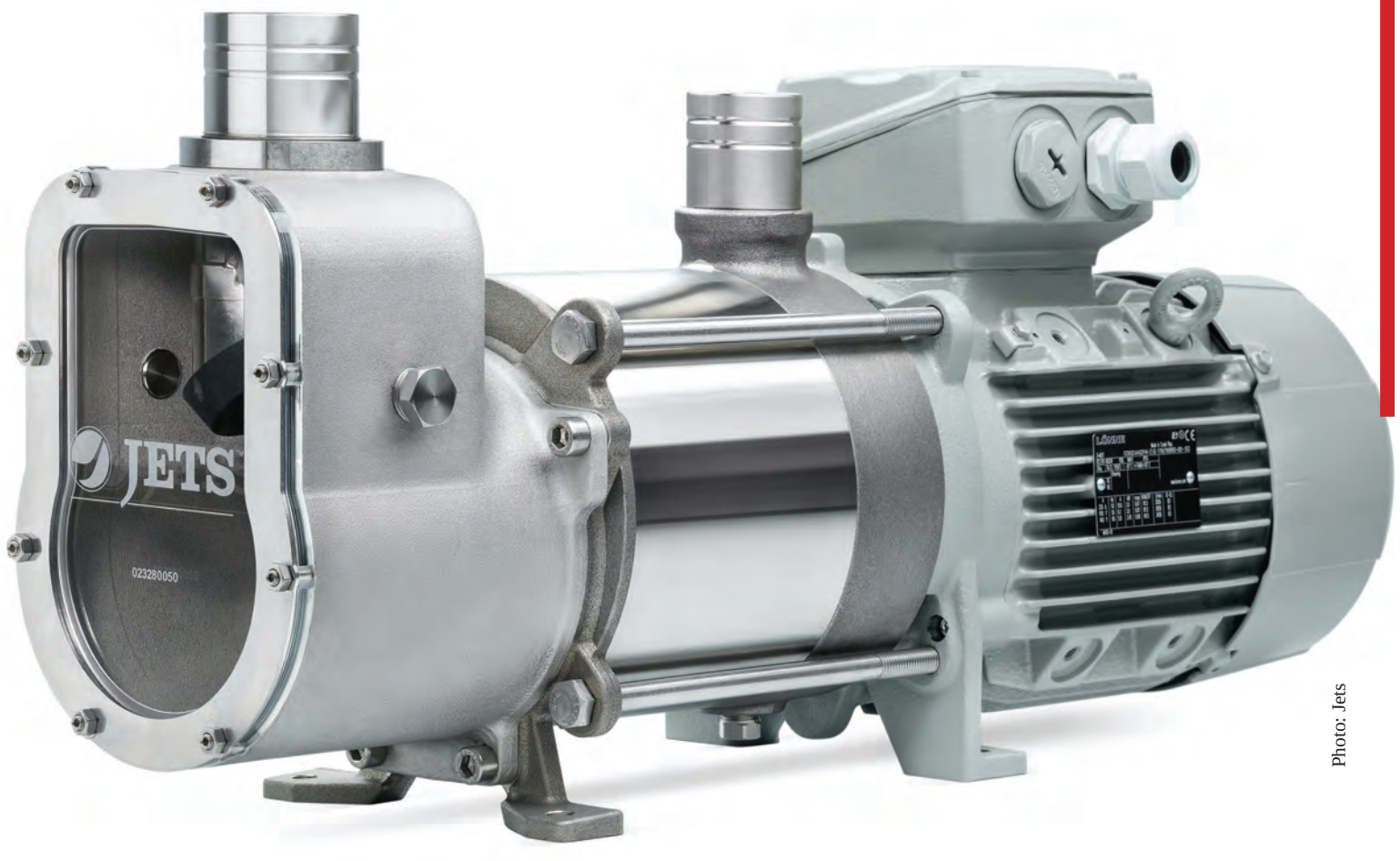


Photo: Jets

The very-low-water-consumption Jets Edge can be used in ships, yachts, cabins, and trains: anywhere a compact, high-capacity and low-energy sanitary system using a minimum of water is needed.

SIMNAV bridge simulator.

Institute of Nautical Sciences & SIMNAV in Brazil

BY CLAUDIO PASCHOA

For a long time there has been a deficit of trained maritime officers in Brazil, as for decades the only accredited training institutes were run by the Brazilian Navy, where a very limited number of prospective maritime deck and engine officers could be trained at its two training institutes in the country. That's all changing now with the Institute of Nautical Sciences (ICN) leading the way.

With the discovery of the pre-salt in 2007 and the continued growth of the maritime and offshore sectors, the lack of qualified Brazilian officers became acute. For many years, and even today, most offshore captains and officers are foreigners, while there is a more significant number of local captains and officers in the merchant fleet. Yet compared to most seafaring nations Brazil is still lagging in terms of private maritime training, which until only a few years ago.

With an offshore fleet of more than 400 vessels operating along the large Brazilian coast and with expectations of further growth due to the continued offer of offshore pre-salt and post-salt plays in recent and upcoming tenders, expanded training facilities for local maritime officers has become vital to the growth of the maritime sector in Brazil as there is also an unprecedented oceangoing ship construction program under way through the Promef program, whose main client is Petrobras' maritime company Transpetro, which although marred by a corruption scandal, continues to order new built DP capable tankers for oil export and DP capable shuttle tankers designed to unload oil direct from FPSOs located over remote pre-salt plays, usually located around 300 km from the coast.

The creation of the Institute of Nautical Sciences – ICN – as a private organization of public interest whose permanent objectives are the production of knowledge and teaching related to the activities developed in the various segments of the maritime and offshore sector, as well as the socialization of information and knowledge to the community concerned, has been a key factor in increasing the number of trained officers and seafarers in Brazil. "In order to achieve these objectives the ICN has invested heavily in research in order to contribute to the technological development of the sector. The ICN develops courses, conferences, seminars and other forms of dissemination of knowledge and exchange of information, aiming at the continuing the education of the seafarers who already work in this area and the professional training of those who wish to enter the maritime market. The ICN also develops didactic materials, software (programs) and alternative teaching methods in order to support maritime and offshore development in all its segments. The ICN aims to be an international reference in specialized education in the maritime and offshore sectors, with the support of multidisciplinary research and studies, being an innovative organization, based on the principles of the Quality Management System," said Andre Carvalho, Director President of ICN.

ICN has its main office in downtown Rio de Janeiro adjacent to the Navy yard and the Port of Rio, overlooking Guanabara Bay, and also has a large and state-of-the-art training center, on the other side of the bay, in the Municipality of Maricá, around 60 km from downtown Rio. Where large groups of seafarers and prospective seafarers and practice hands on ship operations, safety and survival techniques, utilizing real life boats

ECDIS simulator

Photo: ICN

on davits, helicopter simulators, among other forms of hads on training.

In November 2000, the ICN initiated the development of courses related to IMO Resolution A.891, IMO Resolution 1079 (courses for personnel working on offshore mobile units), concluded in early 2002, after which, following an evaluation by Bureau Veritas, it was accredited by the Liberian Maritime Authority. At the end of the same year, it began the evaluation process carried out by Petrobras, which, on behalf of the Brazilian government, was delegated by the Ports and Coasts Board. In May 2003, it obtained the accreditation of the Brazilian Maritime Authority. The ICN is also recognized by the Maritime Authorities of Liberia, Marshall Islands, and Vanuatu, and has been officially nominated as a Filling Agent by Liberia and Marshall Islands, in addition to its ISO certification 9001 Quality. "Considering the approval of this institution in rigorous evaluations and its commitment to the teaching and development of the maritime and offshore areas, we can affirm that the ICN is an organization of international recognition, whose main highlights are the faculty, composed of researchers and professors with extensive experience, and an internationally accredited quality system," said Carvalho.

Reference in Maritime Training

The Institute of Nautical Sciences (ICN) is a truly a reference center in training for the offshore and maritime sector of international recognition and directly accredited by the major Maritime Authorities of Brazil and from abroad. In addition, in seeking continuous improvement, meeting the expectations of customers, concern with the environmental impacts in its activity, preservation of the environment, working conditions and safety in its processes, ICN obtained the certification in Quality (ISO 9001). Only the Maritime Authority of Brazil (CIAGA and CIAGA) can teach courses for waterways / seafarers (Deck / Machine Helper, Boat Deck/Machinery) with CIR emission (Registration and Registration Book), enabling the crewing and operations of ships, offshore vessels, tugboats and safety craft.

SIMNAV – Bridge Simulator

The modern bridge simulator at ICN was developed in Brazil and is considered a showcase of advanced maritime training, being one of the only such simulators in Brazil and all of Latin America. Simulators have been employed in different areas since the First World War, but have been under intensive development since the late 1940s, along with computer technology, sonar and radar technology. The Navigation and Maneuvering Simulator - SIMNAV - was developed by ICN in 2011 as an aid to the teaching for the preparatory classes for the PILOT CADET exam. The first class occurred in December of the same year.

"As the first bridge simulation system developed entirely in Brazil, SIMNAV is also a technological milestone in the field of maritime training, presenting unique algorithms and system architecture. It offers an ideal environment to familiarize mariners with bridge procedures. The complete bridge station can receive groups of up to five students simultaneously. The SIMNAV system is composed of a command console, ECDIS, radar, communications, and large monitors that reproduce the virtual environment outside the ship. In addition, there is a dedicated station for the instructor, focused on creating and monitoring exercises," said Luis Felipe, Director of the SIMNAV program.

CTO: The Future of Offshore Training

The Offshore Training Center (CTO) is a professional maritime improvement center, located in Itaipuaçu, Maricá, in the northeastern coastal region of the state of Rio de Janeiro, 60km from the capital. It is administered by the Institute of Nautical Sciences (ICN) and offers several courses in the area of maritime and offshore support, duly accredited by the Brazilian maritime authority and by some international authorities. It is the only establishment of its kind in the southern hemisphere. Currently, the project is fully functional, and all facilities are completed: one firefighting exercise yard and the other for specialized exercises; a large water tank for practice with survival and rescue craft; a pool for personal survival exercises; operational and administrative annexes; a helipad; a building for classrooms and simulators, with a total capacity of 300 students, an auditorium for 200 and a parking lot for cars and buses. An accommodation area also provides 30 rooms and bathrooms, which allows the simultaneous accomodation of 120 students, with its capacity expandable to 240 students. "Practically all the simulators at the CTO are

SIMNAV console.

Photos: ICN

nationally built and developed by the ICN itself. They manage to virtualize various vessels and ship activities such as marine communications (GMDSS), dynamic vessel positioning (DP), loading and unloading (FPSOs/Tankers); maneuvers (Ships/PSVs/AHSVs/Tug Boats) and ballast and demarcation operations. Among the courses offered by the Institute are those of ballast operator, maintenance supervisor, vessel supervisor and platform manager. Altogether, in seven years, more than 25,000 seafarers received certificates issued by the institution and the expectation is that this number will increase significantly in the coming years with the increase in pre-salt and new post-salt exploration activity," said Felipe. With new oil field developments already ongoing in the Santos and Campos Basins, off the Northeast Coast, and in the Equatorial Margin and long with the revival of cabotage, and increase in inland waterway navigation, private maritime academies such as ICN will be key factors in increasing the number of trainer local sailors and officers to supply the expected future demands of the offshore and maritime sectors in Brazil.

Offshore Training Center lifeboat manevering tank.

Photo: ICN

Students and instructor at the Offshore Training Center.

Ports Pushed to Up *Cyber Security*

"Oh what a tangled web we weave, when first we practice to deceive." That old chestnut gets turned on its head when it comes to port cyber security. It's more like ***"Oh what a tangled web we've woven, so much harder to stop data stolen."***

BY PATRICIA KEEFE

Ports today have the physical aspect of security pretty well nailed shut - gates, locks, fencing, alarms, cameras, drones, etc. As Chris Mason, Rajant Corp.'s director of sales for EMEA, notes, "Every port I've ever been to has signs of physical security – it's the classic physically secure environment."

It's much, much more complicated on the cyber side of the coin. Ports today are comprised of many varied businesses operating via an immense tangle of open and proprietary networked and automated systems supporting all sorts of data storage; back office scheduling, invoicing, cargo manifests, compliance reports, client data; logistics and supply chain software; cargo movements, video, and connections to and between different terminals and transportation modes - on land and at sea. There's voice and data communications over wireless, wired, radio, satellite networks etc., competing in some cases with interference from vendor, client, crew and area frequency signals. And there is security – biometrics, firewalls, authentication, encryption, passwords, anti-virus and anti-malware programs. That's a staggering amount of technology, and every bit it constitutes a potential threat and must be assessed and secured.

> *If something happened today and you go into a court and you haven't trained your mariners in the basics of cyber hygiene, it will be hard to plead ignorance: 'Oh we did not know we were hacked,' It won't fly.*
> ***The folks who manage legal and insurance need to worry about this, not just tech guys.***
>
> **Dean Shoultz**, *CTO, MarineCFO*

Adding to already existing risk within a company or the port as a whole are all the external links to internal systems, the advent of autonomous vessels, the internet of things, the ubiquity of smart phones and other mobile electronics, and even the trend toward creating a single portal through which members of a port's supply chain can access multiple systems.

It's enough to make you ask if whether the ports can, really, ever be made cyber secure. "We ask ourselves that every day," quipped Todd Epperson, port security specialist for the USCG/Sector Upper Mississippi River. He noted that securing inland river ports involves tackling facilities that stretch 70, 80, 90 miles, and encompass 100s of businesses, many small operators – a world away from their coastal cousins.

One Pinpoint

A weak spot at any point in the supply chain digital network could be all a bad guy needs to infiltrate the port systems. "All it takes is one person who has not been trained to not click on a link, and that's it, [a bad guy] is now in," says MarineCFO CTO Dean Shoultz. Once in, malicious software can be launched behind the firewall and the cyber intruder is free to rifle through files looking for financial data, competitive information or the email of key company executives.

Shoultz recounted the case of "one of the larger operators on the market," where an intruder sent out a wave of emails that appeared to come from one of the company's bigger customers, claiming it needed to see an invoice. Just one person clicked on it, allowing an intruder to hijacked the CEO's email address and send a message to the purchasing agent, requesting that she wire a large sum of money to a vendor for some service. Fortunately, the agent thought the request strange, and checked on it.

Ignorance is no longer an option for the port community. "If something happened today and you go into a court and you haven't trained your mariners in the basics of cyber hygiene, it will be hard to plead ignorance: 'Oh we did not know we were hacked,' It won't fly," warns Shoultz, adding "The folks who manage legal and insurance need to worry about this, not just tech guys."

In September 2016, then U.S. Coast Guard (USCG) Rear Adm. Paul Thomas, assistant commandant for prevention policy, summed up the conundrum facing the nation's ports while speaking at a forum on cyber resilience. "The reason that our marine transportation system is efficient and productive is because it is highly automated, and it's becoming more and more so. Cyber is how we are operating today, and more and more we need to figure out how to manage that risk," said Thomas.

Every business sector is using technology to drive efficiencies, productivity and profit, but few are as vital to the national economy and the flow of goods and materials as is the country's system of ports.

One of the nation's most critical infrastructures, the maritime port system employs more than 23 million people, encompasses more than 25,000 miles and includes 360 coastal and inland ports that account for an estimated 90% of U.S. trade, 26% of the world consumer market, and at least $1.3 trillion in cargo.

Country First

If the port communities aren't worried for their businesses (and they should be), consider that from both an economic and a terrorism standpoint, those figures make the U.S. system of ports, individually and together, prime targets. A cyber attack that successfully brings a terminal or port to its knees, and stops the flow of goods and materials, even briefly, can have a devastating effect on the national economy. And because no port is an island, the ripple effect across other ports as vessels get backed up waiting to discharge and pick up cargo, can be equally painful.

There have been several cyber incidents of note impacting U.S. and other ports in the last two years:

- **The best-known incident was the "notPetya" malware outbreak** in October 2017, which struck A.P. Moller-Maersk's IT department, and through that, it's APM terminals at ports worldwide, including at Los Angeles, Long Beach and NY/Newark. The shut down there and at other ports, and the ensuing cleanup of backlog, cost Maersk around $300 million.
- **The recent cyber attack targeting COSCO US**, the American arm of Shanghai- based Cosco Shipping Holdings, took out email and disrupted telephone communications at its customer service center at the Port of Long Beach, and also impacted the company in Canada, Panama, and South America. COSCO connected with clients through conventional communications and social media and never shut down. Armed with a contingency plan, the company isolated the affected network, tested other regions for signs of the infection and transferred and conducted operations via remote access, to ensure continuous service in the Americas.
- **Shipbroker Clarksons revealed it discovered a cyber breach** in November 2017, which had opened up five months earlier, gaining an unauthorized person access to certain company computer systems in the U.K., where they copied data, and demanded a ransom for its safe return. Using computer forensics, it was discovered the break-in was perpetrated through an isolated user account, which was disabled. Eventually, Clarksons recovered a copy of the stolen data. It is now contacting potentially affected individuals.

A Look Behind the Curtin

But the real story lies in what hasn't happened. Port of Los Angeles executive director Gene Seroka told a congressional committee at an October 2017 hearing in the wake of the Maersk incident, that its cyber security center stops "20 million" cyber-intrusion attempts monthly. That's an average of seven to eight attacks a second. Similarly, the Port of Long Beach was beating back 30 million threats a month. That level of assault makes it well worth the more than $1 billion dollars annually that the American Association of Port Authorities (AAPA) says seaports are investing in security-related infrastructure, equipment, operations, maintenance and training.

Chilling as those numbers are, it only takes one successful attempt to get through, and it will happen. The real take away from the Maersk take down is that you can do all the right things, not be the actual target, and still get stung.

Which is why after two years of consciousness raising about the threat of cyber crime, the focus has now shifted to breach response plans, or resilience, and collaboration. Going on the assumption they will inevitably be attacked at some point – deliberately, unintentionally or accidentally – port communities are be-

2 Objectives:

- ☑ Compliance
- ☑ Equipment Protection

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ing urged to move beyond assessing and mitigating their risk. They need to build backup plans designed to get their facilities and operations up and operating as fast and as painlessly as possible.

Port executives will tell you they are working on all that plus some are participating in Area Maritime Security Committees (AMSC) and their cyber subcommittees. Created under the Maritime Transportation Security Act of 2002 (MTSA), the AMSC provide a collaborative forum in which government, law enforcement, the Coast Guard and industry representatives can work together to define, address and potentially, resolve problems, as well as establish best practices, and promote information sharing and resiliency.

Help is on the Way

Peer support and collaboration is one approach to tackling security. Technology is another, and there are plenty of products and guidance on the market capable of tackling cyber security on many levels. Here is a sampling:

• **MarineCFO** is targeting users of its Vessel 365 fleet optimization application suite with a set of "actionable" checklists designed to "engender cyber security into the psyche" of mariners and shore side personnel. With a focus on simplicity and an absence of jargon, the checklists enable mariners to train, record the training, perform cyber drills and improve the physical and digital security of a vessel. Developed around the principles of the NIST 800-171 Cyber Security Framework, the checklists also provide a way to report cyber incidents and attacks.

• **KVH** recently released 6-Level Cyber security, a group of initiatives that it says will provide proactive cyber security protection for KVH hardware and the maritime VSAT satellite network used by its customers.

The multi-part strategy covers the bases, starting with a free KVH Videotel "Cybersecurity at Sea' training video for subscribers to its mini-VSAT broadband service will receive free, the. Based on regulations from the IMO and the BIMCO cyber guidelines for ships, the program covers assessing and reducing risks of a cyber incident, as well as how to recover from an attack.

In the event of an actual or suspected attack, KVH will dispatch a Cyber Security Incident Response Team to investigate, manage and help to minimize the risk.

To better secure its satellite and terrestrial networks, the company provides a mix of tools from infrastructure safeguards, authentication, encryption and proprietary air interfaces. In the latter case, the KVH network keeps satellite traffic off the internet before going through edge security devices at MegaPOPs. To better control shipboard system and internet access, customers can segment the KVH LAN to separate groups or uses, and use the myKVHTM portal to forces personnel to log in. KVH protects internet egress via application-level Universal Threat management firewalls in each KVH MegaPOP, application-level traffic shapers, multiple forms of threat blocking and optional global static IP addresses.

• **The American Bureau of Shipping** unveiled methodology it said will provide a calculated risk index for vessels, fleets and facilities by measuring cyber security risk associated with operational technology and human and machine identities,. Rejecting the standard qualitative approach to assessing cyber risk, ABS says its methodology is unique in that its index quantifies risk. Using its Functions, Connections and Identities (FCI) Model, ABS said it can calculate a cyber risk index for anything from individual assets to entire fleets. An actionable report will enable ABS clients to better target their cyber security investments.

• **Rajant Corp.'s** military-grade, Kinetic Mesh private wireless network provides a fully mobile, highly adaptable and secure connectivity that can turn any asset into a network and never breaks for handoff, ensuring no breaks in application performance. Rajant's "breadcrumbs" – wireless radio nodes equipped with "instaMesh" software – are able communicate with each other via multiple simultaneous connections. el to communicate with each other. Each node supports up to four frequencies and provides configurable per-hop, per-packet data authentication.

The saleable network's peer-to-peer technology, InstaMesh, performs real-time evaluation of network links to direct traffic via the fastest pathways between any wired, wireless or in-motion points. The fully redundant, self-healing network uses a completely distributed Layer 2 protocol to eliminate node or single points of failure. It instantaneously redirects traffic via the next best available link if in the event of a compromised or blocked pathway.

USCG, Naval Academies Address Cyber Workforce Shortages

Back in 2015, then U.S. Coast Guard Vice Admiral Chuck Michel told a Maritime Cyber Security Symposium that "we are incredibly challenged" to develop a workforce that can recognize and deal with maritime cyber security threats. He said the Coast Guard and other agencies needed to make it a priority to build such a workforce. "The key to this thing is not equipment. It is human beings."

But the shortage of cyber-savvy security expertise has only worsened since the symposium, so much so that just when the maritime transportation system has begun to respond to appeals to start addressing the cyber security threat, it finds itself facing an even bigger challenge – a continued and growing shortage of knowledgeable, experienced personnel.

At the **U.S. Coast Guard**, the addition of cyber space as a new domain of responsibility means it too will need a workforce capable of operating in that realm. Toward that end, the U.S. Coast Guard Academy this fall will launch its first new major in 25 years – a cyber security program that will incorporate elements of fields including policy, law, ethics, operating systems, software design and intelligence. The **U.S. Naval Academy**, meanwhile, is building a $106 million cybersecurity building and has seen interest in cyber operations skyrocket from 22 cyber majors in the class of 2018 to 110 in the freshman class. The Academy graduated its first cyber majors in 2016. **Massachusetts Maritime Academy** offers a minor in Homeland Security to students in all majors. The program aims to provide a broad understanding of the international and domestic security issues involved in homeland security.

The Slow Boat to Cyber Security

Ports are making up for lost time

BY PATRICIA KEEFE

Despite the critical role the maritime transportation system plays in the economic health of the United States, and despite its fairly recent embrace of all things automated – cranes, vehicles, surveillance and even vessels – the sector has been slow to warm to the need to protect its digital systems and assets.

Post 9/11, security concerns about the nation's borders, air space and infrastructure, including ports, moved front and center for a brief moment before other concerns, like the search for victims and perpetrators, the cleanup of the site and city, and legislative debate over homeland security needs versus long-held citizen rights, pushed infrastructure to a back burner.

Still, critics kept up a steady drumbeat of worry over the safety of the nation's ports. In the ensuing years, as port automation grew, physical security was upgraded and nailed down, helped in part by the government's Port Security Grant program.

Mostly talk about cyber security plodded along under the radar until the publication of two damning reports that took the nation's ports, the U.S. Coast Guard and Homeland Security Department to task for not aggressively or adequately addressing port cyber vulnerabilities.

Published in 2013, the Brookings Institution's "The Critical Infrastructure Gap: U.S. Port Facilities and Cyber Vulnerabilities," is still considered valid today. Published in 2014 by U.S. General Accounting Office, "Maritime Critical Infrastructure Protection" (GAO-14-459), directed its critique primarily at the U.S. Coast Guard, which it said had failed to conduct a risk assessment that "fully addressed cyber threats, vulnerabilities and consequences." The GAO also complained that both maritime security plans required by law, and regulation generally, also did not identify or address those same issues.

"...Two If By Sea"

Perhaps spurred by those two reports, concern about lax port cyber security exploded in 2015, as the alarm was sounded loudly one after another, by a raft of industry organizations, government agencies here and abroad, academia, insurance companies, standards groups, think tanks and researchers. Almost simultaneous, together they released a wave of reports, seminars, white papers, primers, strategic plans, directives, resolutions, and even some legislative calls for assessment and information sharing - all addressing what they saw as a deeply worrisome lack of awareness, concern and action addressing the cyber security vulnerabilities of the nation's ports.

Particularly alarmed were participants in a Maritime Cyber Security Symposium hosted in 2015 by the Command, Control and Interoperability Center for Advanced Data Analysis (CCICADA), where speakers warned that "Maritime Cyber Attacks Occur in a World of the 'Quick and the Dead,' and that "Cyber Attacks on Ports and Ships Could be Catastrophic."

Maritime executives too came in for their share of criticism for failing to take the lead in making cyber security a priority, while the sloppy cyber hygiene of employees on the front line got them labeled as the weakest link.

Wherever you looked, regardless of source, the message was loud and clear – do something about cyber security or face serious business consequences – regulation even!

By 2016, the focus was squarely on education. Years have also been spent publishing cyber security guides and checklists, strengthening regulatory directives, completing five-year facility security plans, conducting cyber risk assessments, deploying mitigation efforts, and building relationships in the far-flung, highly complex and competitive port community through participation, in part, in the USCG's Area Maritime Security Committees (AMSC), and their cyber subcommittees, which can be found in most key port areas. ASMCs are comprised of representatives from the USCG, government agencies, law enforcement, shippers, port authorities, terminal operators, harbor vessels, even some clients, all working to identify and address security issues, as well as share information and create best practices, in their areas of operation.

Some of the changes we'll see this year into next is a much greater emphasis on cyber risk management, resiliency and collaboration, as the cyber security community tries to defend against complacency (even the best security efforts will take a hit at some point) by getting maritime companies and ports to create contingency plans to enable them to recover as painlessly as possible from a successful attack, and to encourage them to work collaboratively on building best practices and sharing information about attempted and successful cyber attacks.

United States Coast Guard Navigation Center

The U.S. Coast Guard's Navigation Center (NAVCEN) is involved in a number of activities that have an impact on all Americans, even if they don't realize it. From motorists checking directions with their Global Positioning System (GPS) to boaters to ships coming and going to U.S. ports, the NAVCEN plays an unseen but vital role.

BY EDWARD LUNDQUIST

With a staff of 19 officers, 17 enlisted personnel and 19 civilians, NAVCEN falls under the Director of Marine Transportation Systems (CG-5PW) at USCG Headquarters, and is a tenant command at the Telecommunication and Information Systems Command (TISCOM) base in Alexandria, Va.

The center is constantly interacting with Coast Guard units, headquarters offices, government agencies, maritime stakeholders and GPS users around the world.

NAVCEN supports the U.S. Aids to Navigation Information Management System (USAIMS) and Integrated Aids to Navigation Information System (Legacy IATONIS) databases that serve as the official record of all USCG and private aids to navigation aids to navigation (ATON).

"We provide oversight to the 48 thousand – aides, buoys, fixed structures, that are in the United States that the Coast Guard maintains and manages, to help provide safe, navigable waterways for everyone," said Capt.. Russell Holmes, the NAVCEN commanding officer. "They're all listed in the U.S. Aids to Navigation Information Management System USAIMS."

The legacy IATONIS system produces the weekly and annual Light List which are available for downloading from the NAVCEN website. USCG District offices use IATONIS to create a weekly Local Notice to Mariners, which is available to download from the NAVCEN website. Coast Guard ATON units—such as the inland waterway and ocean going buoy tenders–use USAIMS to update the status and condition of the aids when they inspect and service them. The Coast Guard plans to migrate functionality from the legacy IATONIS system to USAIMS to create one integrated application for all ATON activities.

Most mariners, including weekend pleasure boaters, are familiar with "notices to mariners," and just about everyone has seen a lighthouse or one of the "aids to navigation" that mark channels or warn of shoal water. The NAVCEN manages those local notices to mariners (LNMs) notices, and promulgates them through a broad public distribution system.

LNMs can warn mariners about hazards such as a buoy that is off station, a light that is extinguished, an abandoned vessel, or a recent change to a navigational chart, as well as announce safety and security zones. With the widening of the Panama Canal, larger Post-Panamax ships are now calling at East Coast ports, which have been dredged to accommodate them. That means charts need to be updated with the new depths, or navigational markers repositioned.

"People can report discrepancies on the NAVCEN website, such as if a structure is missing, or a buoy is off station, or a light is burning dim or extinguished," said Holmes. "We make that information available to the district for action. The best way we have of knowing that an aid is not working properly is when we get a report from the public.

Mariners and pleasure boaters can also report discrepancies using the Coast Guard Boating Safety mobile app. "We average about 15 or 20 a month that are reported through the mobile app. They're paying attention. But people aren't fully aware of it yet."

"Each district has a relationship with their local Coast Guard auxiliary, which has programs to go out and verify aids – either by boat or by air," said Gene Schlechte, NAVCEN's Engineering Division chief.

NAVCEN works with the Department of Transportation and the Committee on Marine Transportation Systems, which is made up of 28 federal agencies, to coordinate our activities, and is part of the Future of Navigation working group. The center works with National Oceanic and Atmospheric Administration (NOAA), the Army Corps of Engineers, and the National Geospatial Intelligence Agency, which are responsible for coastal, inland, international and military-related charts. "We have a close relationships with these agencies," said Holmes. "The Army Corps of Engineers is dependent on NOAA's survey fleet for bottom contour information; NOAA is dependent on the Coast Guard for updates on visual aids to navigation, and we're dependent on the Army Corps for information about dredging."

Aids to Navigation team members from Dulac, La., straighten a solar panel that charges the aid's lighting system.

U.S. Coast Guard photo by Petty Officer 3rd Class Thomas Atkeson.

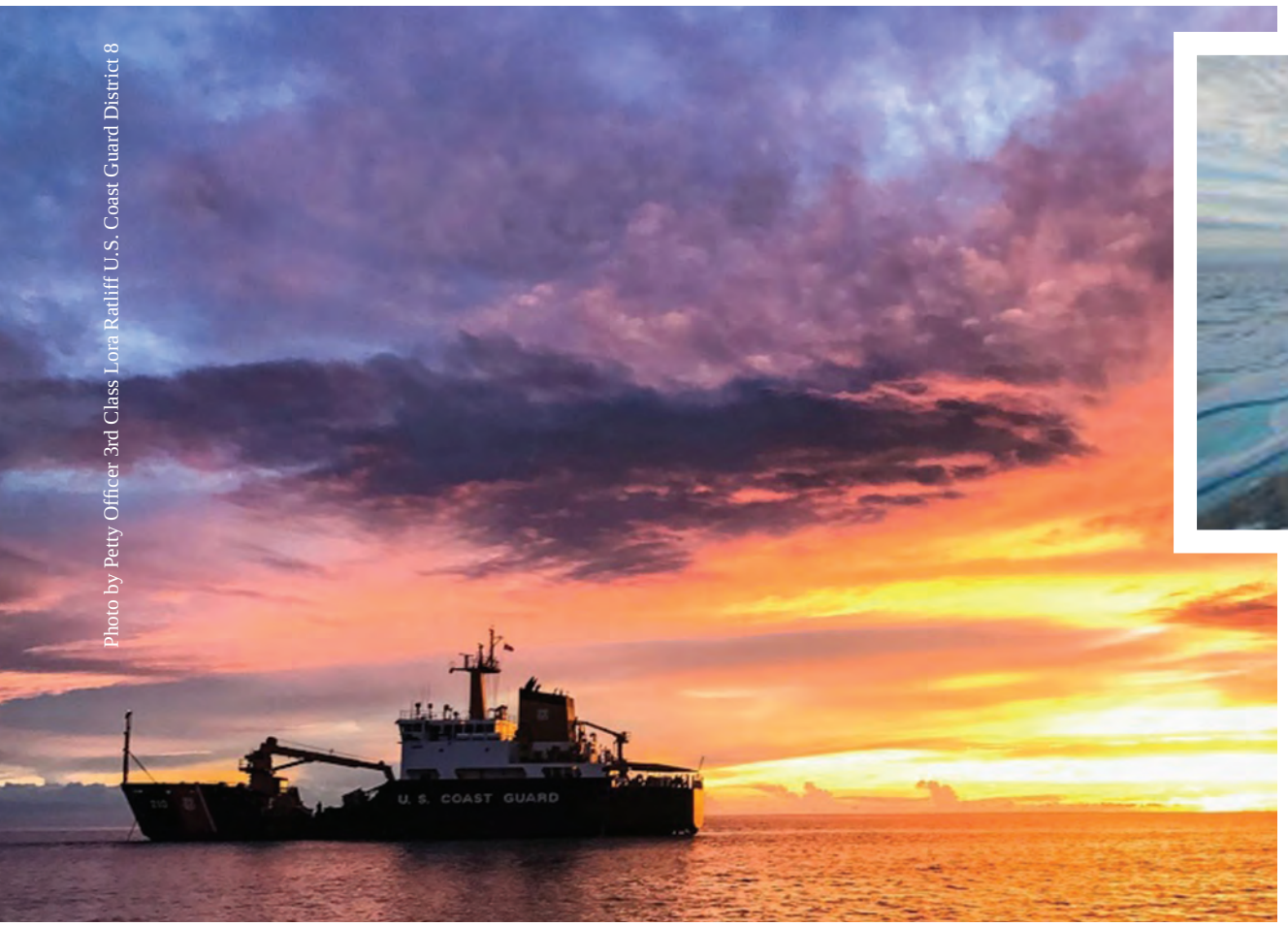


Photo by Petty Officer 3rd Class Lora Ratliff U.S. Coast Guard District 8

U.S. Coast Guard photo by Petty Officer 2nd Class Nate Littlejohn

Above: The crew of oceangoing buoy tender U.S. Coast Guard Cutter Maple follows the crew of Canadian Coast Guard Icebreaker Terry Fox through the icy waters of Franklin Strait, in Nunavut Canada, August 11, 2017.

Left: Coast Guard Cutter Cypress at sunset

With the advent of electronic charts, updates can be made and sent to users in days or weeks instead of months or years. And as charts are updated, the center provide up-to-date electronic charts to Coast Guard cutters and boats.

Global Positioning System

DOT tasked the Coast Guard as the civilian lead for the U.S. government on GPS because of the Coast Guard's experience with LORAN and Omega radio-navigation systems, which were the terrestrial precision navigation and timing systems of their day. Now we rely on global navigation satellite systems (GNSS), which use line-of-sight radio transmissions to provide geospatial position, including altitude or elevation, and time information. GPS is the U.S. GNSS, and uses a constellation of satellites. GPS isn't the only GNSS. The European Union has Galileo; Russia has GLONASS; and China has the Beidou system. There are also other countries that operate systems with limited regional coverage.

Until a recent organizational shift to the newly formed CG Cyber Command, the NAVCEN managed the civil Nationwide Differential GPS (NDGPS) System that employs a network of ground-based reference stations to augment the satellite signals and broadcasts the difference between the positions indicated by the GPS satellite system and known fixed terrestrial positions by calculating differential corrections for its own location and time. The DGPS service also alerts users if any GPS satellite is providing abnormal performance.

NAVCEN participates as the Deputy Chair and Executive Secretariat of the Civil GPS Service Interface Committee (CGSIC), which is chaired by DOT CGSIC is the organization that provides the primary U.S. government interface with civilian GPS users. NAVCEN's GPS responsibilities include receiving GPS outage reports and coordinating the investigation of those incidents with other government agencies. Another Department of Homeland Security entity, the National Coordinating Center for Communications which is part of the National Cybersecurity & Communications Integration Center (NCCIC), deals with a lot of the commercial telephone entities and companies. "They rely on the timing piece of GPS and around 80% of all users are actually using GPS for the extremely accurate time," said Holmes.

"People can call us if there is a problem with GPS," Holmes said. "We gather information from other agencies to share with the public, and we hold periodical meetings with experts who speak about the system, developments, technologies, and different applications of how to use GPS. It's an open forum where it's basically a free shot on goal for anybody to ask questions."

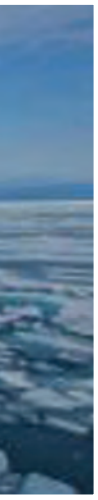
From a resiliency perspective, while we are dependent on GPS for so much, if we lose GPS or satellites for navigation, we still have physical buoys in the waterways. ""We all use our GPS while driving, but we haven't taken down all the exit signs off of the highways, or the street signs off the roads. So we're not just going to remove every buoy out of the waterway," said Holmes. "It's another situational tool to give you awareness of where you are."

Automatic Identification System

(AIS) is the Automatic Identification System and is found on just about all commercial vessels, including towing vessels, and even some recreational boaters. AIS uses Very High Frequency (VHF) radio signals to autonomously exchange information between vessels for collision avoidance. AIS broadcasts information about ship type, length, width, draft and more. "AIS utilizes GPS, so it can provide your location, course and speed. In the past, you'd use your yellow grease pencil and you'd do a plot and a point on a radar screen, then wait three minutes and do another plot, or wait six minutes and use the 3-minute or 6-minute rule to figure out the course and speed of a vessel, so you know how close that vessel will be, and whether you need to maneuver to avoid a collision," said Holmes. "Now you can click a button and then instantly you have all of that information at your fingertips. So it helps from a marine safety and navigation perspective, but it also helps for maritime domain awareness, because we can see which vessels are coming in and out of our ports, and where they're transiting. It also helps with environmental compliance such as speed zones in areas where we need to avoid right whales or low-sulphur fuel emission requirements. If we find a spill, we can see who has been in that area. We can observe that from a distance, just by tracking the vessel movements with AIS. That's why the NAVCEN can support so many of the Coast Guard's missions.

"We do historical data requests for a lot of Coast Guard units and other federal government agencies where they want to do analysis of vessel movements when they may be tracking a vessel from a law enforcement perspective or for marine planning such as wind farm placement," said Holmes. "AIS gives us more domain awareness of what's traveling within our ports and within our rivers and waterways, and it also helps us with doing data analysis to be able to help figure out where the Army Corps might need to dredge more, or where NOAA might need to update charts because you always have waterways that are moving over time, and so you might have a chart that shows land, but now, by looking at AIS data, well you can see a bunch of vessels that are driving over what appears to be land on a chart, but clearly there's enough water under their keel for them to safely transit."

Historical AIS data can be analyzed to inform decisions of dredging or changes to waterways. "The center developed the Vessel Information Verification Service (VIVS) to improve the quality of AIS static data, which in turn improves data analytics and maritime safety on the waterways," Holmes said. "We can look how the trends have changed over



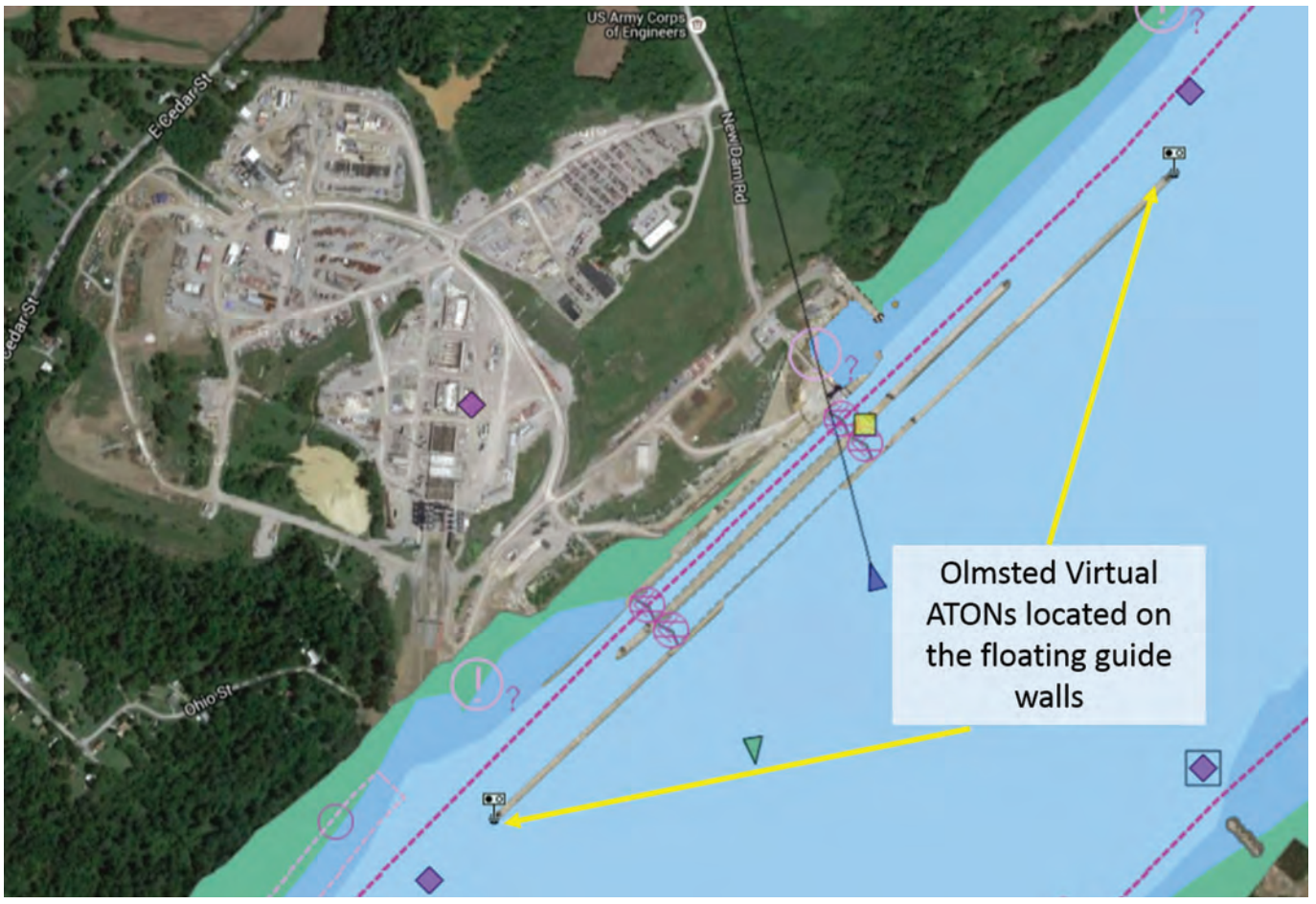


Photo: USACE

Electronic navigation charts display virtual buoys on the Olmsted Locks and Dam floating guide walls. These markers are the first wave in a project to improve safety and efficiency of maritime operations.

time, to be able to continue to provide a safe and secure waterway for all users to be able to operate in."

The center produces heat maps to display large-scale traffic patterns. Data can represent different parameters or information, with different colors to indicate traffic density. The Coast Guard can use vessel traffic heat maps to visualize historical trends by location or vessel type for planning.

AIS also helps port partners and command centers track where Coast Guard assets are. "We educate stakeholders to understand better where the different resources and assets are that are available to help for search and rescue, environmental response, or just from a maritime situation awareness perspective," said Holmes.

The NAVCEN is currently focused on accurate static data, such as vessel dimensions, as well as the correct location of the GPS antennae on the vessel.

"Pilots want to know the correct dimensions of the vessel that's coming around the turn, but they also want to know where that GPS antenna is in relationship to those dimensions. When they see that vessel on their display, what they're seeing is the location of the GPS antenna. They want to know much ship is ahead of that antenna, and how much ship is behind it," said Schlechte.

The center has found that many vessels are actually broadcasting inaccurate AIS information. "We don't believe it's intentional. Maybe they didn't enter the proper information when they installed their transponder, and so they don't even realize that they're broadcasting something wrong. Here at NAVCEN we've worked with the Operations Support Center (OSC) in Martinsburg, W.Va. so that mariners can visit our website and type in any vessel name and it will pull up what they're actually broadcasting via AIS, and what we think they should be transmitting, based on a collection of different databases and the documentation that registered with the Coast Guard and their FCC license. This helps users see whether or not they need to correct their information. If our Coast Guard inspectors are going aboard a vessel they can also can use the Marine Information for Safety and Law Enforcement (MISLE) system to see that information, and help get those discrepancies resolved," Holmes said.

Taking the long view

Long Range Identification and Tracking (LRIT) provides an enhanced level of maritime domain awareness (MDA), with a real-time reporting mechanism to monitor all U.S. flagged vessels, wherever they are, and international vessels bound for U.S. ports. LRIT is both a U.S. and International Maritime Organization (IMO) requirement. It was developed before AIS, and while AIS is open-source, LRIT is encrypted, and uses iridium and INMARSAT equipment. "We have access to all U.S. flagged vessels, and all international vessels that are within a thousand miles of the U.S. coast," Schlechte said. "It's a worldwide system, so countries that participate in the IMO program can identify those ships coming into their ports, and where they are. All LRIT data goes to the IMO, and we get the information that we are entitled to receive from the IMO."

NAVCEN's LRIT watch currently monitors over 7,000 international vessels within 1,000 miles of any U.S. coast, and over 830 U.S. vessels around the world.

Ships must provide notice-of-arrivals to the National Vessel Movement Center 96 hours before they come into port, providing information about the vessel, cargo, crew and previous ports of call. This helps the Coast Guard decide which vessels to board before they come into a port.

"We share the information with the harbor pilots," Homes said. "They know from the ship agents which ships they're working with, and if they see a vessel coming in that they're not planning to help, they might alert us so we can investigate closer. Maybe we should go board that vessel, either out at sea or when it hits the dock, and figure out what is the nature of its business. Sometimes larger recreational yachts don't realize that they're supposed to report that they're coming in to port, or you might have other entities that aren't actually docking at a port, but they're coming in just to exchange crewmembers by boat, and then they'll leave again. But it's not very frequently that most people aren't announcing. The Coast Guard works with the harbor pilots every day for the vessels that are coming in and out of the port. In some cases they won't bring a vessel in until we've given the clearance for that ship to come in. It's kind of a fail-safe," Holmes said. "Our port partners are good about contacting us when something doesn't seem normal."

According to Holmes, ship owners are being more proactive in ensuring their ships are compliant, because they don't want their ships delayed for inspection. "If the Coast Guard finds a lot of discrepancies when they pull into port and then get detained, then it impacts their ability to offload and onload their cargo, and their ability to stay on schedule to their next port and subsequent ports. They may tie up the dock, which also has a big impact on a port. And if they get detentions in the United States from the Coast Guard, it could impact their ability to call at other ports around the world. Others will look at our detention rates and percentages, and may step up their inspections. Whereas if you appear to be doing the right thing and you don't have any deficiencies every time we come on board, we're starting to talk more about how do we get to more risk-based decision making, and maybe we don't need to go on board and squeeze every life jacket."

The center's Navigation Information Service is a 24/7 watch. "It's like a help desk for anybody with navigation-related questions," Schlechte said. "But because we're always manned up, when people are not sure of who else to call, they call us with all kinds of calls about the Coast Guard."

NASA Welding Technologies Could Revolutionize Workboat Fabrication

Solid-State Welding Processes Being Developed for NASA Manufacturing Programs Could Significantly Reduce Workboat Fabrication Costs

BY JEFF DING

Whether it is for a tug boat, cargo vessel, or an offshore supply ship, much of the American workboat fabrication industry is located along the Southern Coast of the U.S. But a visit to any one of the workboat facilities in that area (or any other in the country) would reveal antiquated and archaic fabrication processes used 70 years ago. The workboat manufacturing process is very expensive, labor intensive, and has not really changed since World War II. Perhaps it is time to go back to the drawing board and redesign the workboat manufacturing process from the ground up so that new solid-state welding processes and other aerospace technologies being developed at NASA's Marshall Space Flight Center (MSFC) can be utilized to reduce costs and decrease manufacturing schedules. Although NASA welding development focuses on the aerospace discipline, many applications exist for these same solid-state weld processes in the maritime industry.

Solid-state welding technologies at NASA's MSFC have made significant advances is support of NASA aerospace manufacturing applications. In addition to conventional friction stir welding (C-FSW) and self-reacting friction stir welding (SR-FSW), both of which are used in Space Launch System (SLS) cryotank manufacturing, MSFC is also developing the ultrasonic stir weld (USW) and the thermal stir weld (TSW) processes. These two processes are superior to FSW in that the heating, stirring, and forging elements are decoupled to allow independent control of each element. This allows for greater process control. The process advantages of all three solid state processes (FSW, USW, and TSW) result from the fact that the solid-state weld process takes place in the plastic phase below the melting point of the materials being joined. This precludes any possibility of solidification defects. The benefits include the ability to join materials that are difficult to fusion weld, for example 2XXX and 7XXX aluminum alloys, magnesium, and copper. Solid-state welding processes can use purpose-designed equipment or modified existing machine tool technology, and they are also suitable for automation and are adaptable for robot use.

Other advantages are as follows:

- Low distortion and shrinkage, even in long welds.
- Excellent mechanical properties in fatigue, tensile, and bend tests.
- Single pass welds.
- No arc or fumes.
- No porosity.
- No spatter.
- Ability to operate in all positions.
- Energy efficiency.
- One stir tool can typically be used for up to 1,000 m (3,280 ft) of weld length in 6XXX series aluminum alloys.
- No filler wire required.
- No gas shielding for welding aluminum.
- Some tolerance to imperfect weld preparations; thin oxide layers can be accepted.
- No grinding, brushing, or pickling required in mass production.
- Ability to weld aluminum and copper of >75 mm (3 inches) thickness in one pass.
- Once welding parameters are established, very, very few weld repairs required.[1]

Thermal Stir Welding

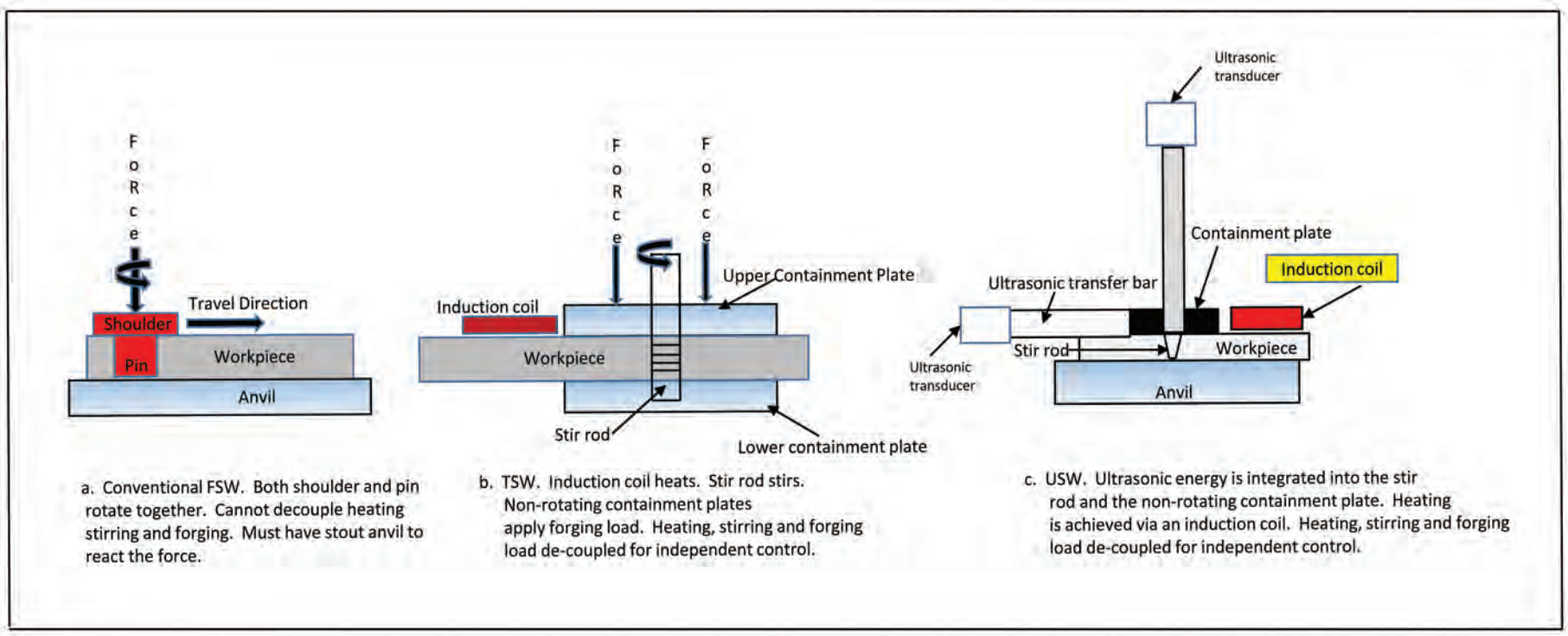
Before the introduction of the TSW process, it should be pointed out that FSW is a joining technology that is expanding in its application to space structures as a solid-state joining method with joint properties superior to fusion welding joints. FSW methods are primarily associated with high-strength aluminum alloys such as the Al-Li alloys used to manufacture cryogenic tanks, supporting structures, and rocket fuselage components. There is high interest in expanding FSW joining methods to higher-strength and higher-temperature alloys to include rocket engine components and other high-temperature materials applications for space. However high frictional forces and high stir welding temperatures make this a difficult challenge.

NASA has developed an innovative variation of the FSW process called Thermal Stir Welding (TSW), a process that introduces additional heat to the workpiece independent of the frictional heating between the stir tool and the metal. A description of the TSW process appears in **Figure 1** and it shows the differences between the FSW and TSW processes. In FSW, the stirring RPM of the stir tool, the heating from the shoulder rubbing on the surface of the weld joint, and the compressive forging force from the shoulder cannot be decoupled. TSW decouples the three process elements and allows independent control of each. The stir tool RPM is independently controlled as well as the compressive forging loads from the upper and lower containment plates. The heating is independently controlled using an induction coil. Because of the independent control of the process elements/parameters, the real benefit of TSW is especially biased to thicker-section plate material and higher strength heat resistant alloys (i.e. titanium, steels, Inconels, etc.) where there is a mismatch between the stir parameters required to sustain frictional heating and the stir parameters desired for the hot working regimes of the alloy. Not to say that TSW'ing would not be beneficial for welding aluminum. It is capable of welding all aluminum alloys whether it is thin sheets or thicker sectioned aluminum, all in a single pass.

The development of the TSW process has led to the fabrication of a full-scale machine, shown in **Figure 2**. It was used to support previous work funded by the Defense Advanced Research Projects Agency (DARPA) and Office of Naval Research (ONR). Deliverables for this project was to successfully demonstrate the single pass joining of .500-in-thick (25.2-mm-thick) commercially pure (CP) titanium and Ti 6-4 ELI.

Since the TSW process de-couples the stirring, heating and forging functions of the FSW'ing process and allows independent control of each process element, novel and very unique applications/capabilities can be attained using the TSW process over the FSW process. Since the TSW process configuration uses non-rotating containment plates (instead of a rotating shoulder in the FSW process) to apply forging loads to the plasticized weld nugget, it is possible to form the upper and lower containments plates to a specific, unique geometry. This was done in the referenced work completed for DARPA/ONR. One of the deliverables was a hexagonally shaped structure which represented a sub-scale gun turret sub-component. **Figure 3** shows one of the angled welds while **Figure 4** shows the completed part. Note that the

Figure 1 Schematic showing difference between FSW, TSW and USW.



a. Conventional FSW. Both shoulder and pin rotate together. Cannot decouple heating stirring and forging. Must have stout anvil to react the force.

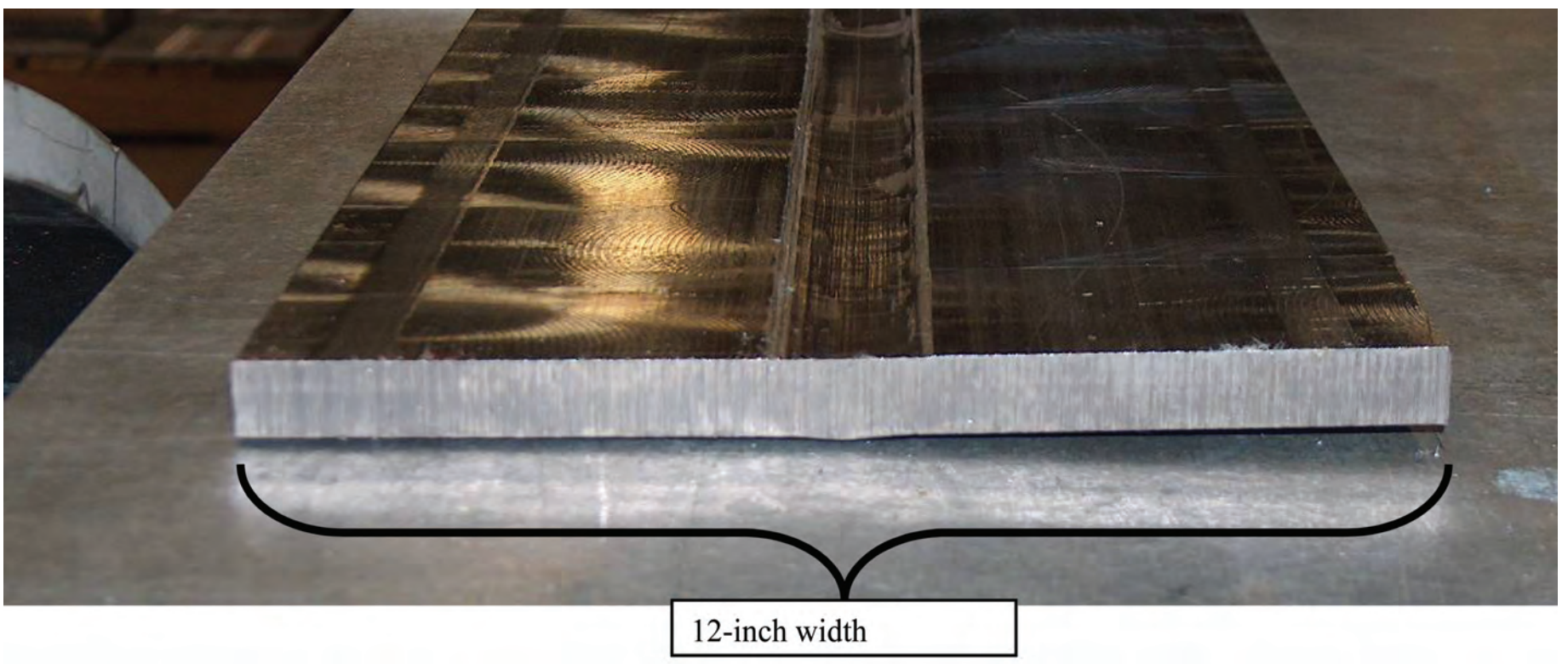
b. TSW. Induction coil heats. Stir rod stirs. Non-rotating containment plates apply forging load. Heating, stirring and forging load de-coupled for independent control.

c. USW. Ultrasonic energy is integrated into the stir rod and the non-rotating containment plate. Heating is achieved via an induction coil. Heating, stirring and forging load de-coupled for independent control.

Figure 2 TSW Gantry Machine Used for Titanium Welding at MSFC

Figure 3 *CP Ti .500-in thick angled weld outside and inside*

Figure 3 *Completed TSW of .5-in (12-mm) thick CP Titanium. Note the minimal thermal distortion.*



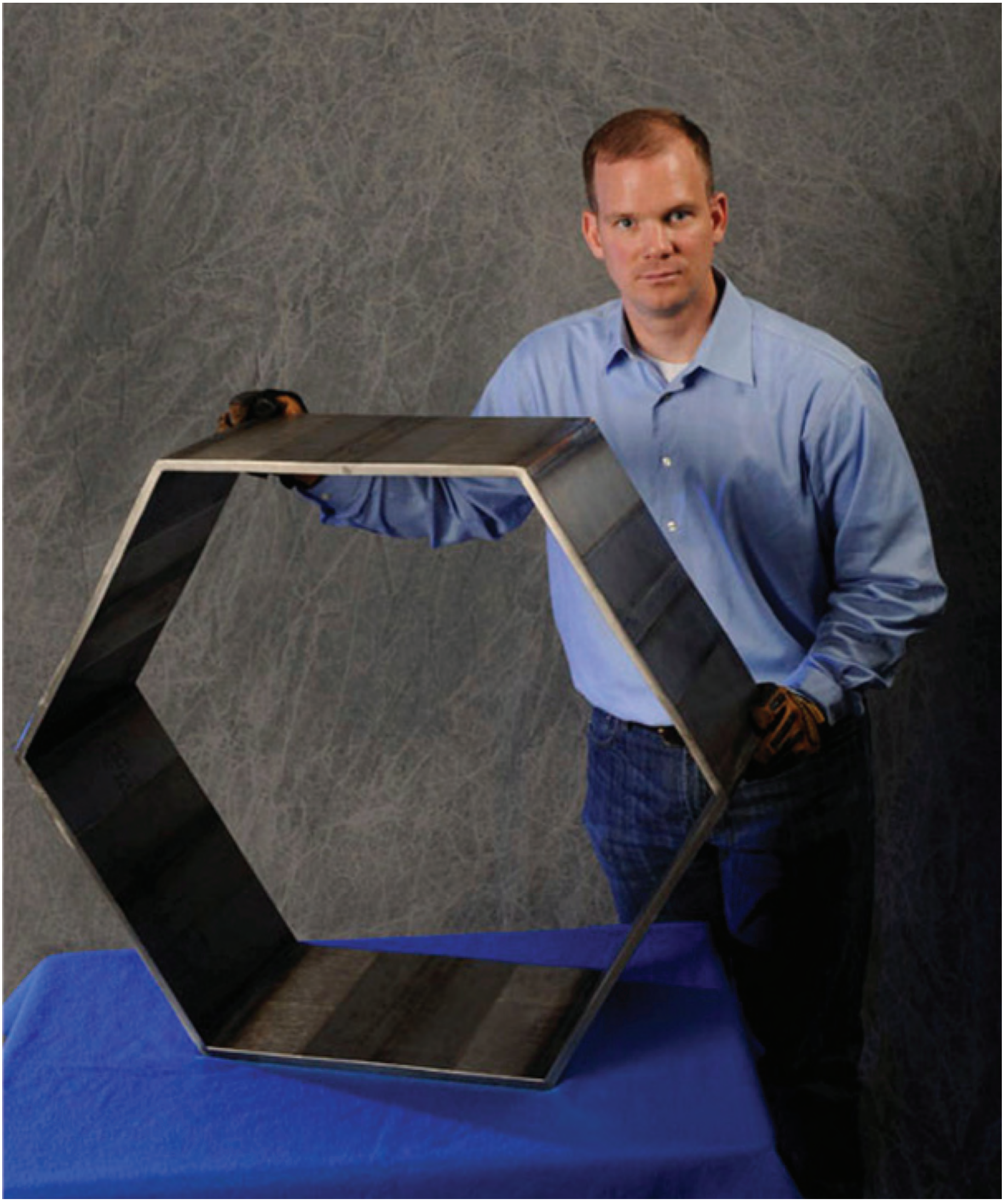
weld joint prep is a 60 degree angle and the stir tool travelled through the angled weld joint prep in a single pass. Another application for which the TSW process would be ideal is for the welding of lap joints.

Another advantage of the TSW process is the capability to weld using real time temperature control. This requires precise real time monitoring and control of the temperature in the weld zone. An example would be the welding of titanium where it is desirable to maintain the weld nugget temperature below the beta transus temperature of approximately 890C. (1,634F). In order to maintain this weld nugget temperature, the proper induction coil temperature must be balanced with the deformational heating to assure the target temperature is reached and maintained during the entire joining process to produce a homogenous microstructure. In so doing, an input target temperature of 870C (1,600F) is entered into the control system. The induction coil heats the weld workpiece to the input temperature, at which time, the workpiece moves between the upper and lower containment plates which clamp down on the workpiece with a desired forging force. The stir tool then begins stirring the weld joint. If the temperature sensor sees the weld nugget temperature fall below the input target temperature, the travel rate slows and/or the stir tool RPM increases and/or the induction coil power is increased. These three events, either independent or in tandem, will increase weld nugget temperature. If the input target temperature is exceeded, the travel rate will increase and/or the stir tool RPM will decrease and/or induction coil power will decrease all of which have a cooling effect on the weld nugget. One of the most important data points relative to excellent welds is knowing that a constant temperature is maintained during the weld with little fluctuation.

Ultrasonic Stir Welding

USW is similar to TSW'ing in that the stirring RPM, heating, and compression-

Figure 4. *Hexaganal CP Ti structure showing angled TSW welds.*



NASA has developed an innovative variation of the FSW process called Thermal Stir Welding (TSW), a process that introduces additional heat to the workpiece independent of the frictional heating between the stir tool and the metal.

al force of the containment plate have been de-coupled for greater process control. It is different than TSW and FSW in that ultrasonic energy is integrated into the rotating stir tool and the non-rotating containment plate. Figure 1 shows a schematic of the process and Figure 5 shows the USW prototype located at MSFC. The benefits of using the USW process include single pass welds in aluminum and heat resistant alloys, decreased plunge forces in the Z axis, decreased friction forces in the X axis, decreased shear forces in the X axis, increased travel rates, and increased stir tool life.

Isogrid and Orthogrid Structures

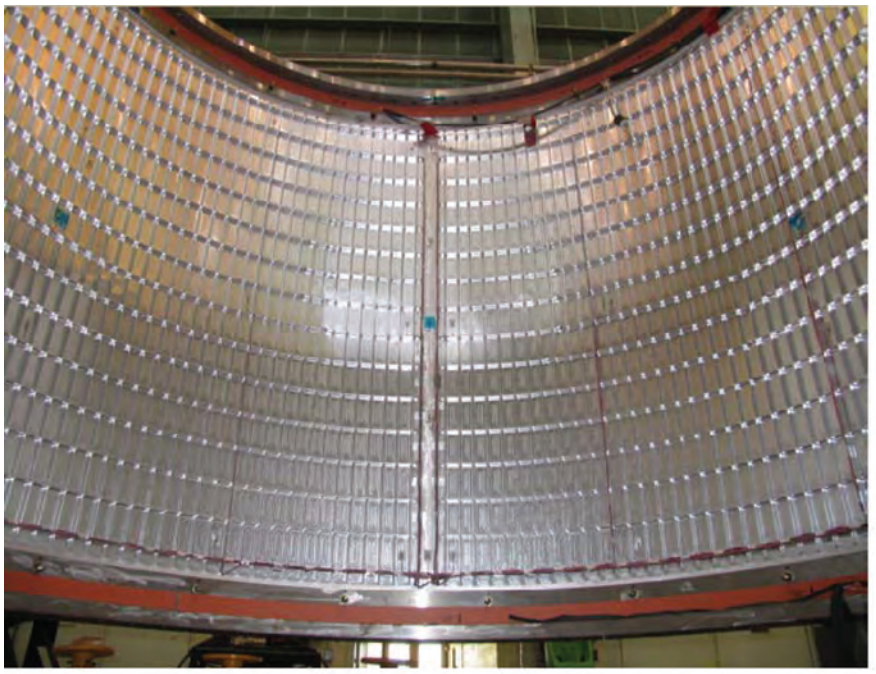
Manufacture of Space Launch System (SLS) rocket hardware, primarily cryogenic tank structures, takes advantage of the superior strength and rigidity found in Isogrid and Orthogrid structures. Figure 6 shows integrally stiffened Isogrid and Orthogrid structures. Both Isogrid and Orthogrid structures contain integrated stiffeners that characteristically have exceptional strength-to-weight or stiffness-to-weight ratios for many applications besides aerospace propellant tanks. Isogrid is able to withstand both compressive and bending loads, making it ideal for space and aerospace applications. Orthogrid has similar benefits to Isogrid, however it differs in terms of its structural pattern – the stiffening ribs use a square or rectangular waffle pattern rather than triangular. Both self-stiffened configurations are used where low weight, stiffness, strength and damage tolerance are important.

Using NASA Technologies for Maritime Applications

Applying aerospace technologies to maritime applications would definitely be a challenge. A “bottoms-up” ap-

Figure 5. ***USW Prototype system at MSFC.***

Figure 6. Orthogrid and Isogrid integrally stiffened structures.



Orthogrid structure

Isogrid structure

proach would have to be implemented beginning with stress and failure analysis which would lead to preliminary hull designs. New boat hull designs could focus on the elimination of hundreds of structural stiffeners, thus reducing labor and inspection costs significantly. The new designs would allow the use of new advanced solid state weld processes and materials; the same ones used in NASA's space hardware manufacturing and R&D programs such as the Space Launch System Program. Cost benefit analysis and trade studies would lead to the break-even point for new technology infusion into the maritime industry. A manufacturing prototype demonstration article could be fabricated and tested showing the cost savings benefits of automated solid state single pass welds with far superior strength than manual fusion welds, as well as further cost savings and positive schedule impacts using automated real time weld inspection processes. Recognizing advanced manufacturing processes and techniques are used and being developed for aerospace applications in the U.S. aerospace industry, perhaps the maritime industry sector should investigate the technologies outlined in this article as well as other advanced materials and processes available to modernize shipbuilding efforts. Possible pathways to modernization include consortiums, partnerships and other co-development arrangements that can focus on maritime manufacturing applications.

Due to limited space, this article has been abbreviated and touches on the highlights of technology used and developed for NASA manufacturing programs. For more detailed information, contact Mr. Sammy Nabors, Technology Transfer Program, Marshall Space Flight Center, 256-544-5226.

[1] *The FSW process was used in the External Tank Manufacturing Program in support of the Space Shuttle Program. FSW was used to complete longitudinal welds in the last six liquid hydrogen (LH) and liquid oxygen (LOX) tanks. The only known FSW defect occurred in manufacturing when the power went off half way into a twenty foot LH tank weld. After Material Review Board (MRB) disposition, it was decided to qualify a FSW repair technique, thus, preventing the scrapping of the liquid hydrogen tank.*

About the Author

Jeff Ding began his career at NASA's Marshall Space Flight Center in June, 1986. His education includes a B.S. in Biology, Bowling Green State University 1976, B.S. Welding Engineering, The Ohio State University 1986, and a Masters in Science, University of Tennessee 1993. He brought the friction stir welding (FSW) process to the NASA agency in 1995/1996 time frame when he secured a 14 ton Kearney and Trecker Horizontal boring mill and converted it to NASA's first FSW system. He completed his first FSW welds November 1996. He continued FSW development as well as ultrasonic stir weld (USW) and thermal stir weld (TSW) since 1996 and has authored 13 U.S. patents in solid state welding technology.

Avoid Headaches & Pitfalls

Response Services & Non-Tank Vessel Response Plans

The summer of Sub M may be over, but the heat remains for the tugboat and towing vessel industry operating under the July 20 regulations. Owners and operators are faced with daily challenges to continually sustain and build their businesses. As with any new regulation, there is a period of learning and, even more so, interpretation by industry and by those enforcing regulations. One of the more significant matters related to this situation revolves around vessels in response services and those required to hold Non-Tank Vessel Response Plans (NT-VRP). Navigating through these regulations can be complicated, but this article will help identify how to avoid those potential pitfalls and headaches.

It is important to start with some basic background on why tugboats and towing vessels have been required to maintain certified Non-Tank Vessel Response Plan (NT-VRP) prior to Subchapter M. The heart of the issue is found simply in the CFRs (Code of Federal Regulation). Subchapter M is part of 46 CFR, which refers to Shipping. 46 CFR is focused primarily on safety of a vessel through inspections, training and equipment standards. Whereas, response and spill mitigation requirements are found in 33 CFR which refers to Navigation and Navigable Waters, including pollution prevention. Each section of CFR identifies those vessels, individuals or sectors of industry that must comply with the regulation.

There are four areas that owners and operators should currently evaluate within their own operation that may involve a potential operator oversight or conflict between their Subchapter M Certificate of Inspection (COI) and what may have previously worked in their response services or NT-VRP approval (33 CFR 155, Subpart J) process.

Those potential conflicts may include:

1. Geographic Limitations
2. International vs. Domestic Tonnage Requirements
3. Total Number of Manning (for Certain Response Services)
4. Conditions of Operation & Restrictions

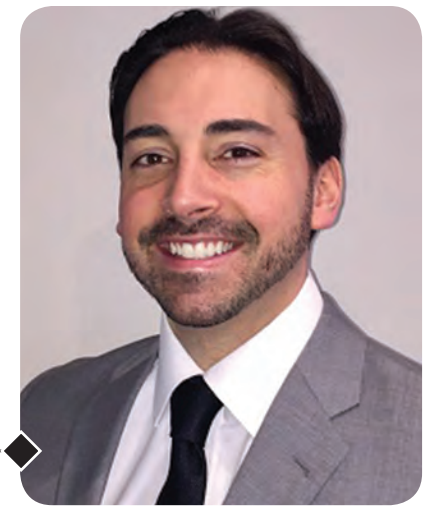
Let's examine those four areas a bit closer.

1. Geographic Limitations:

Owners and operators must understand that vessels must comply with permitted routes that their COI authorizes them to operate on. Geographic limitations to operating areas and restrictions on operating conditions may now be different than the vessel's capabilities at the time the NT-VRP was approved. Currently, the United States Coast Guard will not be providing any additional grace periods for operators to comply with this Subchapter M requirement.

The COI permitted routes does not restrict the vessel to a Geographic Specific Area (GSA), but rather is classified by the restricted distance from land that a vessel may operate. Terms such as Inland, Great Lakes, lakes, bays,

About the Author



Richard Paine is a licensed mariner, certified TSMS & AWO-RCP Lead Auditor and DPA with over 20 years of maritime and auditing experience ranging from deep sea, tugs & towing, and passenger vessels. He is an alumnus of SUNY Maritime College in both undergraduate and graduate studies. A member of PVA's Safety & Security Committee, he is currently is the Regional Director, HSSQE for Hornblower's NYC Ferry & Statue Cruises operations. Richard can be reached at rjpaine-jr@gmail.com

sounds and rivers, limited coastwise beyond 3 nautical miles, coastwise not to exceed 20 nautical miles and oceans are placed on the vessel's COI to distinguish this permitted operating distance.

It is important to know that the COI identifies permitted routes based off the operating distance from land, not through specific Captain of the Port (COTP) zones or GSA. Due to this measurement process, it still allows operators to navigate lengthy voyages. If a vessel's COI states limited coastwise beyond 3 nautical miles, the vessel can transit along the east coast to the Gulf of Mexico. However, the vessel must operate within 3nm from land for the entire voyage.

2. International vs. Domestic tonnage requirements (NVIC-01-05)

Prior to Subchapter M, some may not have known that there were two different ways to measure a vessel's tonnage. The traditional domestic gross registered tonnage (GRT) was typically the only reference to measuring a vessel's tonnage for many years. However, there is a second means to measurement, referred to as gross tonnage (GT) measurements using the international tonnage certification (ITC) (46 USC 14302 (the Convention measurement system)). ITC has been in place since 2004, but did not require vessels without this measurement to get it done. The critical and complicated piece to know is that both are tonnage measurements, however, both have drastically different numerical outcomes. Vessels may have 99 GRT measurement, but a 400 GT (ITC) measurement. USCG NVIC 01-05 was published nearly 13 years ago to help support and provide guidance on the topic along with the process of identifying the NT-VRP requirements.

Owners and operators must be aware that this international measurement changes many regulatory compliance areas, specifically in 33 CFR Part 155 for response plans, including salvage and firefighting operations. Although, ITC has not been hidden to the world, it is important to realize that Subchapter M has opened up this requirement to inspectors, auditors and others.

3. Total Number of Manning (for Certain Response Services)

The tugboat and towing vessels industry is beginning to see the first round of COIs be issued across the nation. One of areas noted on the COI that has drawn the most attention is to the manning requirements placed on the vessel.

Vessels operating in salvage and marine firefighting and other emergency services may notice that additional manning requirements have been required on their COI. This requirement is intended to ensure that vessels meet regulatory planning criteria including manning resources to reinforce existing efforts among plan holders and their respective service providers in geographic specific areas where their vessels operate. Additional manning is not uncommon to see on vessels that have specialized non-routine services.

4. Conditions of Operation & Restrictions

The last area for owners/operators to evaluate is related to restrictions or special conditions to operations for their vessel. The conditions of operation may affect your operating prowess, but also have financial consequences that may need to be planned for to limit business exposure. The COI may identify special requirements for weather conditions, such as wind strength or sea state severity that may limit or restrict your vessel operations. Other areas may include carriage of equipment and personnel, or requirements specific to associated services such as salvage and marine firefighting or emergency towing.

Each of these four areas identified are meant to be used a guidance for self-evaluation of your current regulatory standing during the sometimes confusing interpretation period. Additionally, there are other options to provide further support on the subject matter to make sure your operation is running at optimal performance. Events such as Green Apple Spill Response Exercise in the New York City area on September 28, Clean Gulf in New Orleans on November 15, as well as others are great opportunities to evaluate your current response plans and speak with other professionals associated with response efforts. Lastly, remember that you always have a direct route to discuss Subchapter M compliance by contacting to your local United States Coast Guard Sector and the OCMI.

Cutting & Welding

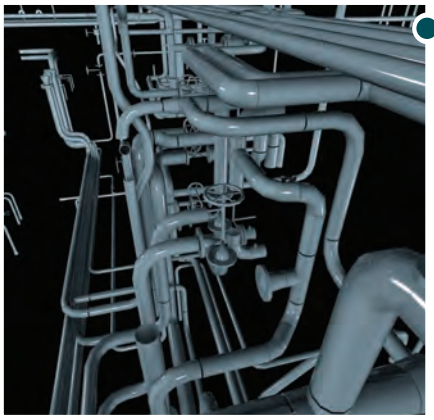
Efficiency and accuracy have never been better with this collection of cutting and welding equipment

Edited By Tom Mulligan

This month's technology review covers the latest developments in metal machining, including new welding tools and cutting equipment, plus new software-based control systems for simple and efficient machine shop operations.

Nowadays, an oxygen plasma of 300 amps with a hafnium electrode can cut more quickly, with better cut quality, and more accurately (especially with holes) on carbon steel than the old 600-amp systems.

Photo: Profile Cutting Systems



Left: For both newbuild and retrofit, vessel users can pair Victaulic's integrated grooved content with ShipConstructor's software to meet specific weight, space, time or cost requirements from preconstruction through completion.

Below: Victaulic grooved joining solutions can leverage SSI's Autodesk ShipConstructor tool to lay out and design piping systems faster and more efficiently.

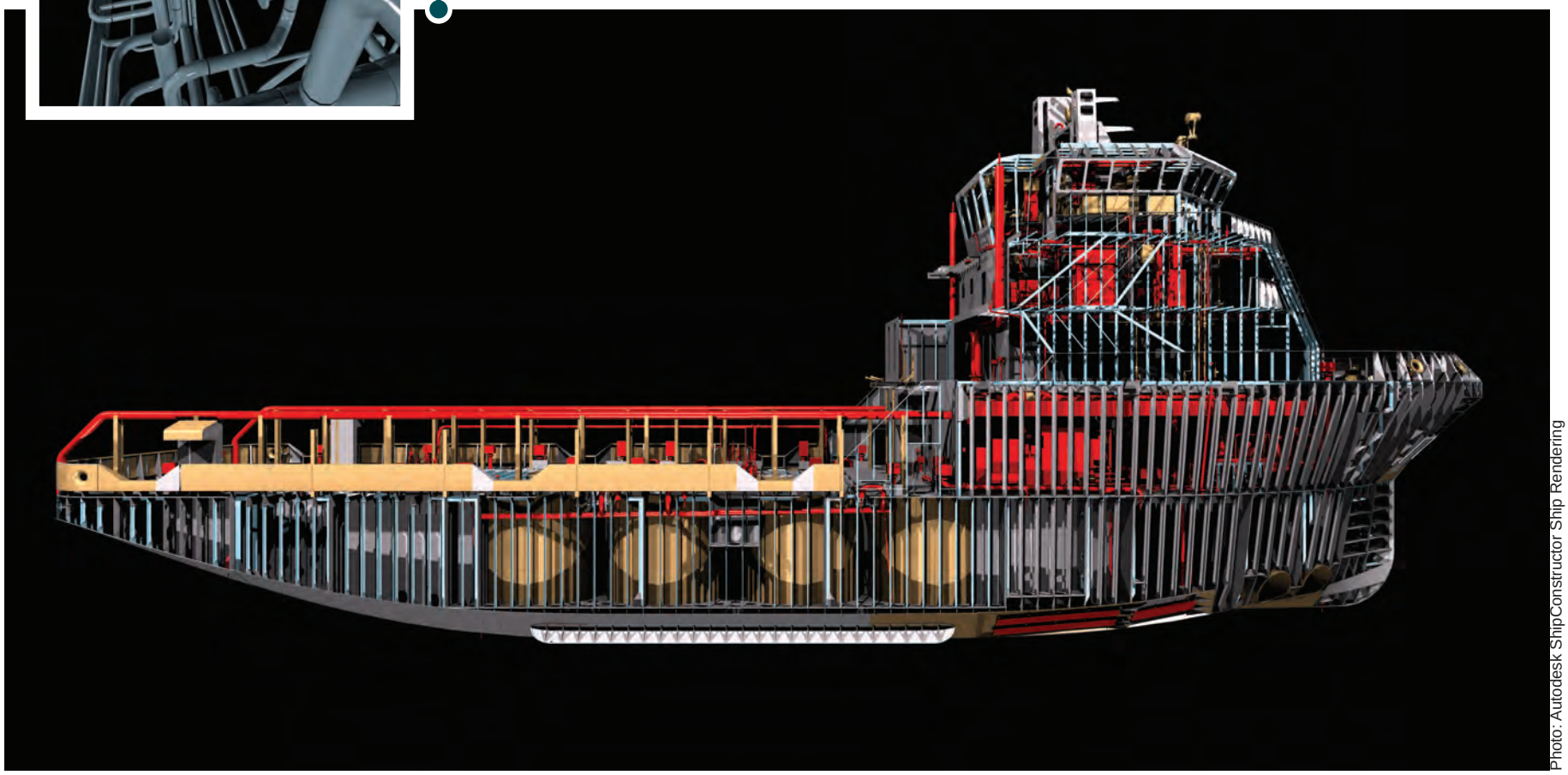


Photo: Autodesk ShipConstructor Ship Rendering

The evolution of CNC Thermal Cutting Systems

There are many cutting systems in use in modern shipyards, including cutting machines equipped with plasma, oxyfuel, marker and bevel heads. Twenty-five years ago there may have been a Legacy CNC with a cathode ray tube and reel-to-reel tape drive still in operation but today the cutting machine is probably PC-based and connected wirelessly to the Internet. This not only enables remote loading of cutting programs but, more importantly, allows remote diagnostics by the manufacturer should operational errors occur. Furthermore, custom software and updates can easily be loaded into the CNC if a new process is added. Machine motion and accuracy have been greatly enhanced with the adoption of digital servo drives, for example the SERCOS digital protocol replaces analog voltage signals for motion control. Motion mechanics has also seen the adoption of linear bearings, where applicable, to replace roller bearings.

Plasma Systems: In the early days of CNC operation, plasma systems used a tungsten electrode, nitrogen as the cut gas, carbon dioxide as the shield and 600-amp systems were common. Nowadays, an oxygen plasma of 300 amps with a hafnium electrode can cut more quickly, with better cut quality, and more accurately (especially with holes) on carbon steel than the old 600-amp systems. Modern systems are now software-controlled and, with remote diagnostics, can be accessed through the CNC. Changes in performance are now coming very quickly, making it difficult to keep abreast of developments. Where once there were only three gasses available for ideal cutting parameters, there are now more than six, including steam. Plasma, however, is still the most economical way to shape-cut stainless steel and aluminum.

Oxyfuel: Oxyfuel is still 'the old standby' and the most economical way to cut carbon steel more than two inches thick. However, several changes and innovations have occurred: in the past if optional height control and ignitors were ordered, after about six months it was typical that the operator would remove them as they were seen to get in the way, were subject to moisture, slag and dirt, and only had a simple motor for up/down movement. Nowadays, internally-built height control, internal torch ignitors (ones that work), and servo control up/down movement are common, and no tools are required for tip changes. For full automation, the CNC can set oxygen-fuel ratios to include flow rates for different thicknesses. Another modern development is that various preheat fuel gasses are now available.

Beveling plate: Beveling, whether of the plasma, oxyfuel or triple-bevel oxyfuel variety, has seen a number of changes in hardware and software. Software still needs more development but is improving all the time in the quest to make the job as simple and repeatable as possible. Some bevel heads now have zero offset, which greatly helps the programmer, especially with internal bevels. The head itself can achieve all the required angles (+/-47.5°) while the machine remains completely stationary. The older styles of bevel heads are less accurate, less repeatable and cannot perform blind bevels. Modern systems are much more compact and it is possible to purchase plasma beveling on a 5 foot X 10 foot machine. Oxyfuel beveling is now benefiting from servo control for ease of set-up and operation and can also have continuous rotation without operators having to perform an unwind operation due to twisted hoses.

Marking: Twenty-five years ago, zinc marking or punch marking were the common methods of marking but now there is a choice of punch, pin, plasma, ink-jet, zinc, and laser marking for both layout, part identification, and even for bar coding in any axis.

Drilling: Modern cutting systems can be equipped with processes that can drill, tap, countersink and even mill, and multiple auto tool changers are now common. Some systems can drill a three-inch hole through five-inch material in 60 to 90 seconds. Such processes

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Photo: Brush Research Marketing

Widely known by the brand name Flex-Hone, the ball-style hone is a highly specialized abrasive tool that features small, abrasive globules permanently mounted to flexible filaments for deglazing, de-burring, edge-blending and cross-hatching.

Combining the Scotchman Digital QuickStop programmable measuring system with the Scotchman CPO 350 saw enables operators to increase production while reducing scrap and operator error in the machine shop.

Photo: Scotchman

Photo: Hougen Manufacturing

The new HMD2MT magnetic drill from Hougen Manufacturing allows for more tooling options by utilizing a #2 Morse Taper arbor system, enabling fabricators to not only drill holes with annular cutters but also to use taps, reamers, twist drills, drill chucks, countersinks and other tools.

have become popular because material handling is costly. Shipyards can save a lot of money if their cutting systems can produce finished product without multiple material handling while also avoiding processing errors that may occur. In addition, the introduction of through-tool MQL (minimum quantity lubricant) improves drilling and eliminates both the inconvenience and cost of using flooding coolant.

Cutting tables: There are multiple advantages and disadvantages in using water, downdraft and self-cleaning in cutting systems. If the cutting system is equipped with a drill, hold-down forces can be of the order of tons - this would crush an older-generation table.

www.pcsusa.pro

Speeding up Cylinder Servicing

Modern cargo ships are real workhorses that spend most of the time at sea and being dead in the water from an engine failure is very costly for their operators/owners. As many maritime crews do not include diesel mechanics, it is important that repair and maintenance shops are able to provide engine repair or overhaul services quickly and thoroughly: the main challenge is servicing ocean-going engines including most of the international big-bore models such as those from Sulzer, Yanmar, Daihatsu, MAN B&W and MAK.

When carrying out overhauls or repairs that involve cylinders, it is expected that cylinder liners will have to be deglazed and cross-hatched, and for these jobs a compact, portable and highly efficient tool, the ball-style hone, is often employed. Widely known by the brand name Flex-Hone and the nickname ‘dingleberry’, the ball-style hone is a highly specialized abrasive tool that is instantly recognizable by its unique appearance. It features small, abrasive globules that are permanently mounted to flexible filaments and is a low-cost tool that is particularly favored by mechanics and metalworkers due to its deglazing, de-burring, edge-blending and cross-hatching capabilities.

Whether used for cleaning, de-burring or plateau finishing, this tool provides a low-temperature abrading process that exposes the undisturbed base metal to produce a long-wearing surface free of fragmented, amorphous or smeared metal from previous operations. Available in various grit sizes and diameters up to 50-plus inches, Brush Research Manufacturing (BRM) offers a line of Flex-Hones that are particularly suited to heavy-duty applications.

Brush Research Manufacturing has also been active in solving difficult finishing problems with brushing technology in the sophisticated environments of nuclear energy, aerospace and computer technology, as well as in other industrial applications.

www.brushresearch.com

Scotchman Digital Measuring System

Scotchman’s RG Digital Quick-Stop, coupled with a Scotchman CPO 350 cold saw, is designed to make a manual machine into a part-cutting workhorse with repeatable accuracy. Made in the U.S., the saw and programmable measuring system work together seamlessly to increase production while reducing scrap and operator error in the machine shop. Entering cut lists into the controller makes it easy to make accurate cuts every time.

Backed by a three-year warranty, the Scotchman CPO 350 is an industrial-grade circular cold saw with 100° of mitering ability, a dual-clamping self-centering vise, and a chip drawer. The saw has a two-speed motor and utilizes up to a 14-in. diameter blade, giving it a 4-7/8-in. OD round capacity that consistently produces burr-free, high-quality cuts.

Increased production and reliable stop position accuracy of ±.008” can be achieved by coupling the saw with an RG Digital Quick-Stop measuring system. Operators can change lengths quickly by using preset hotkeys and easily adjust measurements on a 7” touchscreen Android tablet or they can upload a complete cut list using the system’s Bluetooth & WIFI capabilities.

www.scotchman.com

Streamline Maritime Pipe Modeling

Victaulic and SSI have come together to streamline maritime design and construction by integrating Victaulic content for MEP in SSI’s Autodesk ShipConstructor software so that design firms and shipyards that choose Victaulic grooved joining solutions can leverage the tool to lay out and design piping systems faster and more efficiently. For both newbuild and retrofit, vessel users can pair Victaulic’s integrated grooved content with ShipConstructor’s innovative software to meet specific weight, space, time or cost requirements from preconstruction through completion so that pairing this new maritime pipe modeling content with Victaulic’s grooved pipe joining solutions reduces the time and effort required to complete maritime projects.

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The POWER MIG 260 offers superior welding performance and a multitude of professional features for MIG and Flux-Cored welding in light industrial shop fabrication, maintenance and repair work.

Photo: Lincoln Electric

Arc welding manufacturer Miller Electric has introduced the new Dynasty 280 DX with CV, a multiprocess welder capable of AC/DC TIG, MIG and stick welding.

Photo: Miller Electric

Photo: ESAB

from Hougen Manufacturing allows for more tooling options by utilizing a #2 Morse Taper arbor system, enabling fabricators to not only drill holes with annular cutters but also to use taps, reamers, twist drills, drill chucks, countersinks and other tools. Other features of the new drill include a two-speed motor with forward/reverse, seven-inch stroke, double dovetail slide, a pilot light, a coolant system, a hex wrench holder, a two-stage magnet, and the Hougen operator safety system. The HMD2MT has the capacity to drill holes up to 1-5/8" in diameter, tap holes up to 5/8" and ream holes up to ¾"diameter. The drill weighs only 40 lbs.

www.hougen.com

Simplified Fabrication with POWER MIG 260

Lincoln Electric has introduced its latest innovation in welding machinery, the POWER MIG 260 for MIG and Flux-Cored welding in light industrial shop fabrication, maintenance and repair work. With an ergonomic design, the POWER MIG 260 simplifies and streamlines the welding process while Lincoln Electric's patented ArcFX technology provides instant graphical feedback on the user interface, illustrating how wire feed speed and voltage affect the weld outcome. The memory capability enables users to load and save weld settings, while its adjustable features allow for a customized welding session.

Set-up for this machine is quick and easy with its Ready.Set.Weld feature. Push-and-turn digital controls and a seven-inch, full-color display guides users through the process for intuitive and simple set-up and operation.

The unit comes complete with a Maxtrac Wire Drive, Magnum PRO 250L Welding Gun, quick storage accessories, 10foot work cable with clamp, gas regulator and ten-foot power cable with plug. Additional features include a coil claw for an organized work station, a side-mounted tool holder, and an angled gun connection for improved feedability. The unit also offers an easily accessible front-mounted 115V power outlet with gun connections.

www.lincolnelectric.com

Portable solution for Multiprocess Welding

Miller Electric introduced the Dynasty 280 DX with CV, a multi-process welder capable of AC/DC TIG, MIG and stick welding. Weighing 55 lbs, this portable machine is suitable for the shop or jobsite for applications that include shipbuilding, construction, precision fabrication, heavy fabrication, pipe and tube fabrication, and maintenance and repair.

With this new welder, operators can TIG weld 0.012" to 3/8" aluminum and 0.004" to 3/8" steel. The machine offers superior arc performance and the ability to TIG weld with AC waveforms, including advanced squarewave, soft squarewave, sine wave and triangular wave. The CV output of the machine delivers MIG welding capabilities when paired with a SuitCase X-TREME voltage-sensing feeder that is powered off the arc voltage of the power source and can run both solid and flux-cored wires.

The Dynasty 280 DX with CV delivers up to 280 amps for welding and includes Auto-Line technology, which allows for any input voltage hookup from 208 to 575 volts with no manual linking. This provides convenience for any job setting and is ideal for applications where there is dirty or unreliable power. In addition, the machine uses high frequency (HF) on starts only in order to eliminate HF interference issues during welding. Blue Lightning high-frequency arc starter technology provides non-contact arc initiation, resulting in more consistent arc starts and greater reliability compared to traditional HF arc starters.

Operators can make precision adjustments using the machine's all-digital controls for greater quality control and repeatability. The Dynasty 280 DX with CV also includes Pro-Set technology, which eliminates guesswork when setting weld parameters: operators simply select the feature and adjust the setting until Pro-Set appears in the display.

www.millerwelds.com

Arcair's SLICE Exothermic Cutting System

Arcair has completed a major upgrade to its SLICE exothermic cutting system, providing for a more ergonomic torch grip and oxygen flow lever, and protection for the operator's hand from molten spray when piercing. To extend striker life, the new striker assembly incorporates a slide mechanism that enables the operator to expose the copper ignition bar in small increments, shielding the fresh portion.

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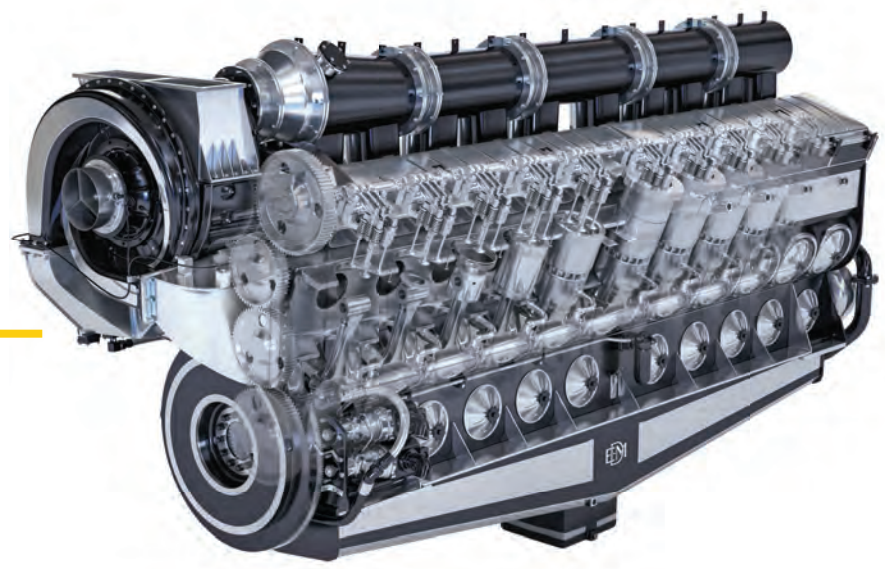

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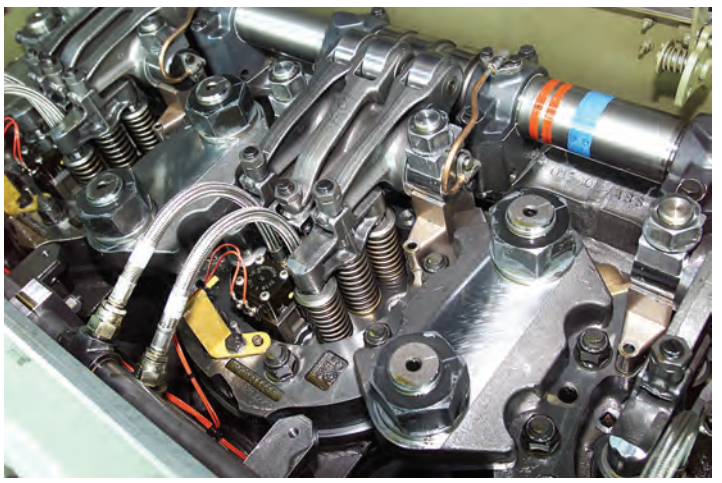

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