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MARITIME REPORTER AND ENGINEERING NEWS

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October 2018

The SNAME Annual Marine Design

Decarbonization, Digitalization, Autonomy & the Future of Ship Design

The Future of Class
Classification evolves with industry

The LNG Solution
TOTE shares three years of success

Propulsion Tech
The evolution pace quickens

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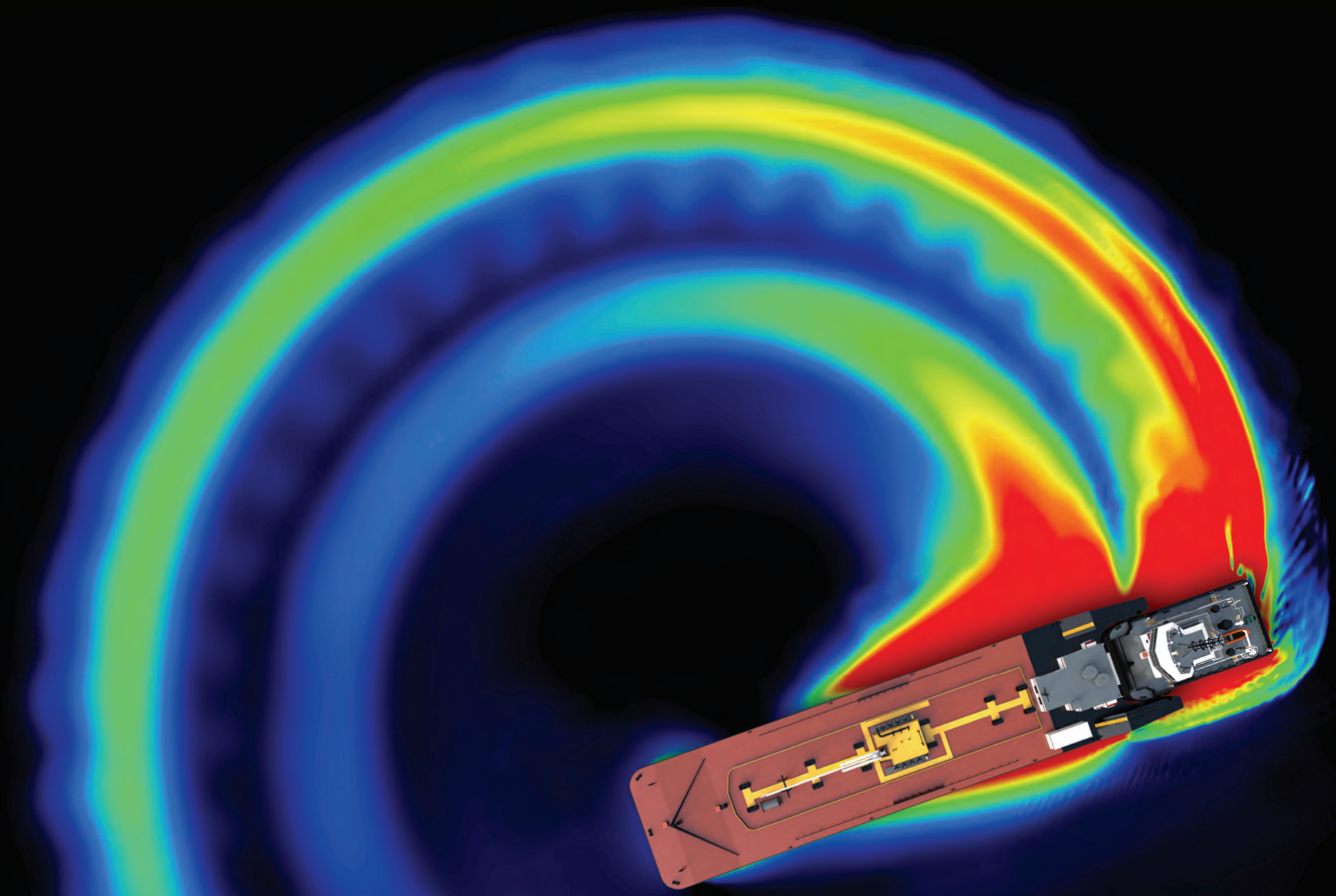

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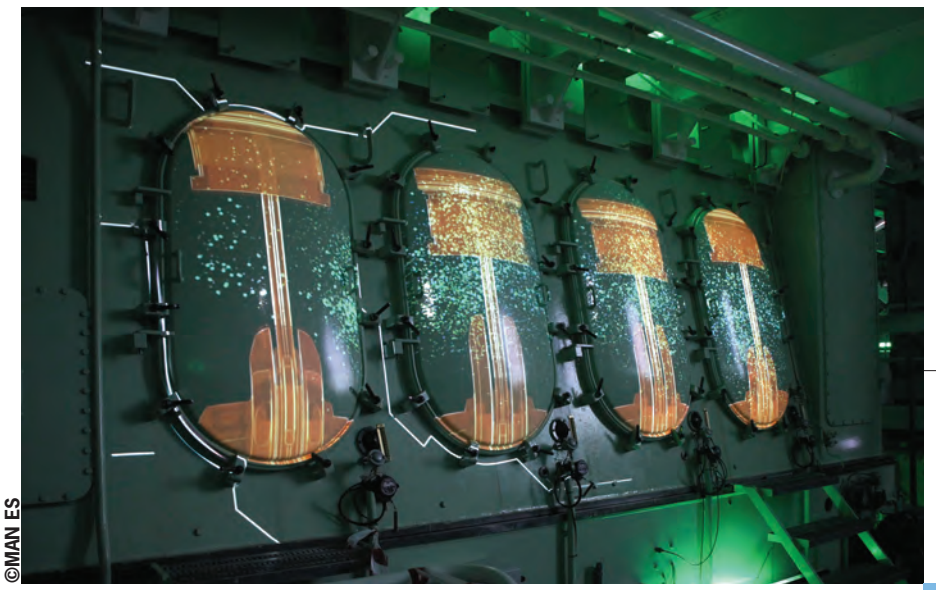

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26 LPG to the Fore

MAN debuts the new MAN B&W ME LGIP engine.

By Peter Pospiech

30 TOTE's LNG experience

TOTE's Peter Keller reports LNG is a success.

By Greg Trauthwein

TOTE

CELEBRATING 1893 | 2018

125

SNAME

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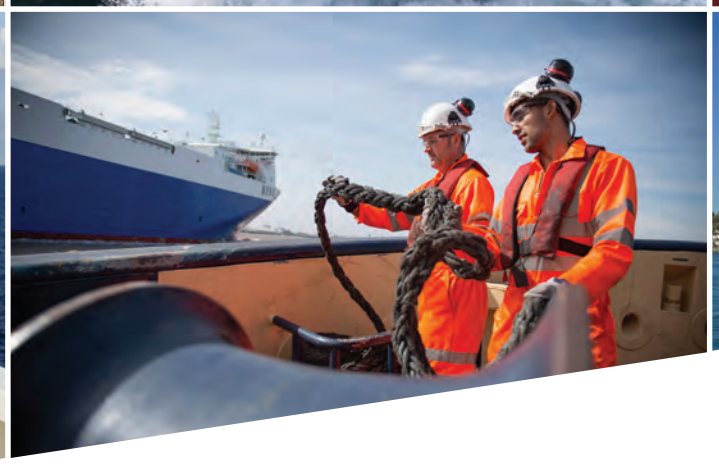


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Happy 125th SNAME!

Putting this October edition together has been one of the most challenging, yet informative, editions in recent memory. With our partners at the Society of Naval Architects and Marine Engineers (SNAME) – which is set to celebrate its 125th anniversary milestone this month at its annual convention scheduled for October 24-27, 2018, in Providence, Rhode Island – we offer here in our "Marine Design" edition. I would argue that nearly any edition of *Maritime Reporter* could be dubbed the marine design edition, as all that we talk about literally starts in the minds and at the desks of naval architects and marine engineers. But in putting this special 36-page "SNAME 125" section together with the new leadership of SNAME, it became clear from the first meeting that a historical retrospective was out, instead the editorial focus was to look at the most compelling issues driving maritime in the coming generation, a 'thought leadership' section that melds with the society's master plan to rebuild, rejuvenate and significantly grow SNAME.

Starting on page 32, this "SNAME 125" section includes insightful, in-depth features on the three big drivers in maritime design today: Decarbonization, Digitization and Autonomy. But we start with a welcome message from SNAME's executive director on page 36, as well as **Gene Sanders'** vision of SNAME for the future. Sanders pulls no punches in delivering his thoughts on what is wrong, what is right and what is the potential for this society serving a proud group of professionals.

In step with its anniversary, SNAME is set to break new ground with its first female president in 2019, **Suzanne Beckstoffer**. While I am fairly certain that the majority of our readers know Beckstoffer, I invite you to read our one-on-one interview with her starting on page 39, as the interview transcends her 30+ year career at Newport News Shipbuilding, with insights on her path to a technical career in maritime and her vision to groom the next generation.

While this marine design section is packed, I would be remiss to not single out the work of contributing editor **Patricia Keefe** who attacks the topic of decarbonization in maritime. In my humble opinion Tish is one of the best writers in our pages, a natural-born journalists with the ability to break down complex issues in an informative and entertaining style. *And what, today, could be more entertaining than cutting your emissions by 50% by 2050?* While significant emissions reductions and alternative fuels is still an overwhelming minority of the world maritime population, rest assured change isn't coming, change is here. While we won't see complete emission reductions in maritime in my lifetime, the course is set and this will be the technological trend driving the next generation of ship and boat development.

If you're looking for a 'future fuel tech' story playing itself out on the waterways today, turn to page 30 for insights on TOTE's three-years of experience running its new ships almost exclusively on LNG. As most of you know TOTE made headlines 5+ years ago when it announced plans to build the world's first containerships fueled by LNG. Well time flies when you're having fun, and those ships have nearly three years in service operating in the Caribbean. At SMM in Hamburg we had the chance to interview Peter Keller, EVP of TOTE, who offered an unfettered view of the risks and rewards of operating on LNG, as well as some insightful tips for those considering the switch.

Gregory R. Trauthwein
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LEADING THE FUTURE

THE COVER

As the Society of Naval Arcitects & Marine Engineers (SNAME) celebrates its 125th year, we dedicate our Marine Design Annual to examining indepth the mega trends driving marine design for the coming generaton: Decarbonization, Digitalization and Autonomy. This 34-page feature section starts on page 33.

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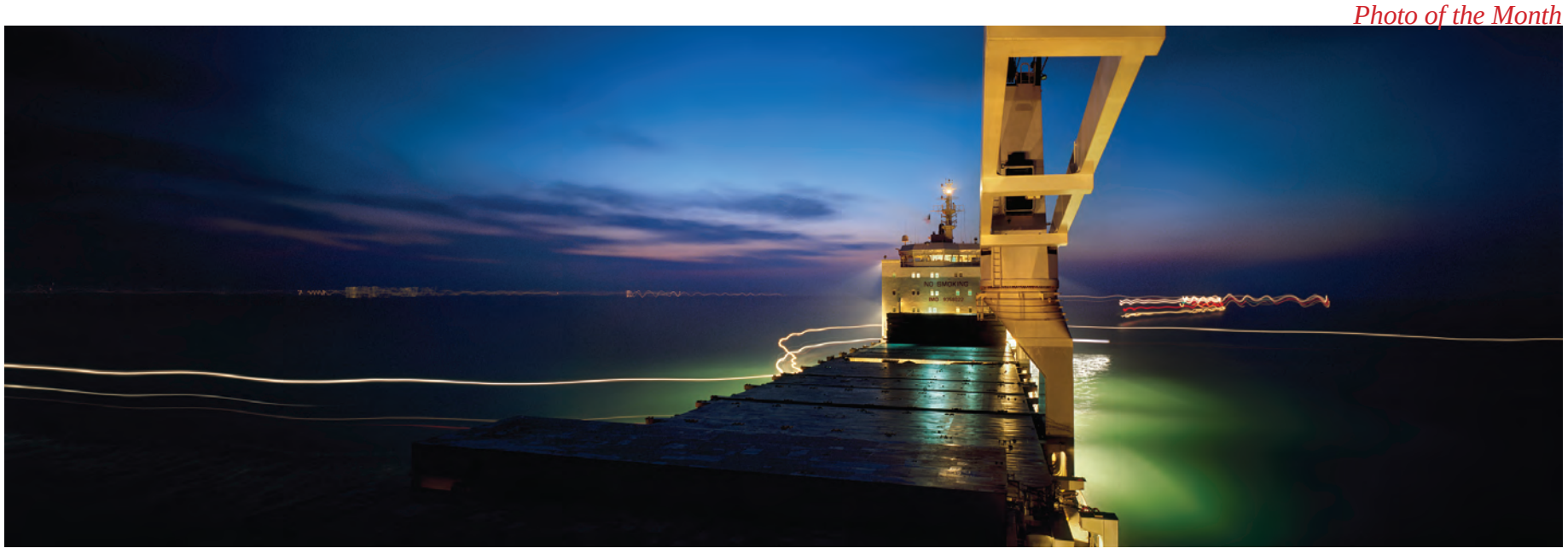
In this Edition

Voices: Marco Ryan

Wärtsilä's Chief Digital Officer eyes the future, and it's digital and connected.

By Greg Trauthwein

Photo of the Month



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Arrival of pilot boat at night.

Herbert Boettcher worked out the photo on a heavy lift vessel during his trip through Europe, the Asian part of Turkey and his passing the Suez Canal. He flew back home from Egypt. Today, this vessel sails with the Name Maple Lotta.

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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MarTID 2019

Autonomous Operations and the Future Mariner

By Michael Manuel, Associate Professor, Head - Maritime, Education and Training (World Maritime University);
Murray Goldberg, President and CEO (Marine Learning Systems); and Greg Trauthwein, Editor & Associate Publisher (New Wave Media)

The second annual global Maritime Training Insights Database survey examines the impact of the autonomy trend in maritime operations on the training of future "seafarers"

The Maritime Training Insights Database (MarTID) steering group is pleased to announce the upcoming launch of the 2019 MarTID survey, which this year focuses on the trend toward autonomous vessel operations and its impact on training current and future mariners.

MarTID is a non-commercial, joint initiative of the World Maritime University, New Wave Media and Marine Learning Systems. Its core principles include ethical integrity, objectivity and confidentiality. It was launched in 2018 with the completion of the inaugural survey and publication of the 2018 Training Practices Report (which can be found at www.MarTID.org). The steering group takes this opportunity to thank again the many respondents to the first survey.

This MarTID initiative is an important one, the first of its kind in the world. There is broad agreement that roughly 80% of maritime accidents involve human factors causes. As such, vessel operators and maritime training centers are pouring significant resources into creating best practice and innovative training programs. The MarTID database, which will grow in breadth and depth annually, shines a bright light on the training approaches and successes of global vessel operators and training centers. For example:

- *What are the global trends in training budgets?*
- *What is the average training amount spent per seafarer?*
- *What training technologies are considered effective and which training models are growing in their adoption?*
- *How confident are vessel operators and training centers in the training methods they employ?*

All of these and much more are answered in the 2018 Training Practices Report.

With the information in the annual MarTID reports, training leaders are able to benchmark their own results, learning from the successes and failures of others, rather than independently inventing and designing their own training approach in isolation.

Without the ability to monitor and measure past efforts - to learn from the approaches others have tried - trainers cannot continually improve. The annual MarTID survey and report is designed to enable this continual improvement in maritime training.

The 2019 survey, to be launched in the fall of 2018 and closed early in 2019, is designed to further the mission of MarTID: to provide a global picture of maritime training that is not currently available. While last year's survey was designed to collect a broad set of foundational training data, this year's survey will be shorter and consist of two foci.

RESOURCES

- Read the 2018 Report
  http://digitalmagazines.marinelink.com/NWM/Others/MarTID2018/html5forpc.html
- Visit the MarTID Website
  http://scholar.wmu.se/martid
- Watch the Video
  Murray Goldberg talks MarTID on MR TV: www.marinelink.com/videos/video/murray-goldberg-discusses-martid-100167
- Participate: Your Opinion Matters!
  To take the survey, e: info@MarTID.org

The first section of the survey will focus on collecting benchmark data tracked annually, revealing trends in core training issues. These include training budgets, training models, training staffing, the use of technology, major training initiatives, and seafarer demographics.

The second section will focus on this year's special topic: the impact of autonomous vessel operations on maritime training. It would be hard to identify a maritime industry topic which is receiving more attention than the move toward an increasing level of autonomous operations. Differences in data collection, decision support, bridge manning levels, and human involvement in navigation will all greatly impact the need for and the type of training required. This trend has already begun to impact operations and the need for training. If the automobile industry is any predictor of how quickly this might move, then it is incumbent upon maritime training professionals to consider the emerging needs deeply and without delay. The 2019 MarTID survey will enable this process with data upon which decisions can be made and will explore the perspectives of vessel operators/managers, maritime administrators, maritime training experts and seafarers.

The MarTID 2019 Survey

As was the case in 2018, the 2019 survey will be followed by a series of publicly-available reports, broadly published. These reports will provide both high-level and deep-dive information covering both broad trends as well as deep coverage of the 2019 special topic. We believe that these reports will grow to be a highly anticipated source of information each year.

Your Opinion Matters

Although this initiative was founded and run by the three partner organizations, it requires community involvement to succeed. You will be hearing more about the 2019 MarTID survey in the coming weeks and months, but right now, we need your help. Specifically:

- If you work at a vessel operator/manager or maritime training facility, please make your senior training administrator aware of this important survey by sharing this article with them.
- If you are a senior training administrator of a vessel operator/manager or training facility, a maritime administrator, or a seafarer, we need you to complete a survey on behalf of your organization. Please send your contact information to info@MarTID.org and we will reach out to you early in November once the 2019 survey is launched.

We believe that the annual collection and analyses of training data will help the global maritime community gain insights that can lead to enhanced policy-setting, decision-making, benchmarking and operational optimization by industry operators and regulatory authorities at all levels. We hope that the survey data and its analyses will become an important and authoritative source of knowledge for the global maritime community. Therefore, we thank you in advance for contributing to this important body of knowledge.

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LNG report

Floating Liquefaction & Regasification

BY JIM MCCAUL

International Maritime Associates has completed a 12-month study of the global market for floating gas liquefaction plants and floating LNG regasification terminals. The 150+ page study, published by World Energy Reports, is the most detailed analysis yet made of this growing business sector.

Project Success Evaluation

The IMA study is the first professional effort to systematically look at the universe of FLNG and FSRU projects in the planning stage – and categorize the likelihood of each making the development investment hurdle. Many FLNG and FSRU projects are planned – but only some will ultimately will move forward to development. The goal of the study is to objectively sort out likely winners and losers – and explain the rationale for the rating. Employing a qualitative analysis that reflects lessons learned from post-FID FLNG projects, IMA examines 29 floating liquefaction projects in the planning stage and provides its view of whether the project has a strong, fair or weak probability of moving forward. The probability rating is based on how the project scores in terms of drivers of project health and stockholder overlay considerations.

Drivers of project economic health

- gas processing requirement
- gas quality- liquids presence
- upstream location
- FLNG location
- alternative gas commercialization possibilities
- transport distance to the Chinese gas import market

Stakeholder overlay considerations

- strength of the project promoter
- strength of offtake buyer
- government support for the project
- ease of doing business in the resource country

A similar analysis is made of FSRUs in the planning queue. Based on lessons learned from FSRU terminals already in development, IMA provides its view of the probability that each of 47 FSRU terminals in the planning stage has a strong, fair or weak probability of moving for-

The 488-m Prelude FLNG, the world's first floating liquefied natural gas (FLNG) project.

Photo Courtesy Shell

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ward. While the analysis is similar to that used for FLNGs, the success factors are more oriented to the commercial drivers influencing the investment decision in FSRU projects.

Drivers of project economic health

- gas import demand driver
- need for single or multiple gas offtakers
- potential alternative sources of future gas supply
- infrastructure requirements

Stakeholder overlay considerations

- strength of the project promoter
- strength of gas offtake buyer
- government support for the project
- ease of doing business in the resource country

Online FLNG/FSRU Database

IMA does more than just provide a snapshot of the floating liquefaction and regasification sector. Its new online fully searchable LNG database updates all FLNG and FSRU project information on a 24/7 basis. As IMA receives new information about projects from its network of industry contacts, the database is immediately updated to reflect the latest situation.

With access to the online database, users can access any FLNG project or FSRU terminal – in operation, under construction and planned – and immediately find the latest information on project status, along with any changes in timing and probability of the project investment decision. Contacts are also provided for follow up with key players.

Database users are able to select any combination of data about projects and export the data to excel for evaluation – or use the sophisticated sorting and graphics capability provided with the database for making comparisons and benchmarking.

The search capability is user friendly and our IT staff is available to assist with any issues or questions at any time.

Experience of Professional Team

The FLNG/FSRU study and database has been prepared by a small team of seasoned industry professionals with many years of hands-on experience in the offshore sector. The team's direct experience in planning and executing FLNG and FSRU projects provides the foundation for a "reality check" evaluation of the likelihood that projects in the planning queue will go forward to development.

Jim McCaul, founder of IMA and co-founder of WER, is the principal analyst in the study. He has prepared more than 60 reports on the floating production business -- and over the past 30+ years has been engaged as adviser by numerous clients in the offshore oil and gas sector. Jim has been advisor on planned FSRU projects in Ghana, Jamaica, India, elsewhere.

George Tilley, senior researcher, is a 30+ year veteran of the international oil and gas industry having worked in Brazil, Kazakhstan, India and Tanzania for BG Group. In his last assignment in Tanzania George was responsible for the commercial arrangements with partners and government for the proposed LNG project. Our other senior analyst in the study has 30+ years of experience as offshore field development engineer in offshore oil and gas projects and has been directly involved with planning FLNG projects in Tanzania, Cameroon, Congo-Brazzaville, Brazil and elsewhere.

A Personal Reflection

The Role of the USCG RDC in Electronic ATON's

About the Author

Dr. Charles Judice, IEEE Fellow and USCG Auxiliary FSO-NS. (Note: USCG members Irene Gonin, and Lee Luft contributed to this article.

To recreational boaters, Aids to Navigation (ATON) are the familiar red and green buoys (and day markers) that line our inland waterways. What they might not be aware of is that buoys have been around since the days of the Roman and Egyptian empires. In the decades following the creation of our country, buoys in every shape and color began appearing in our waterways. It wasn't until 1850 that Congress harmonized their deployment, thereby encouraging the familiar "Red, Right, Returning" mantra. Fast forwarding to the 21st century, in response to the terrorist attack in 2001, Congress authorized the USCG to develop a Nationwide Automated Identification System (NAIS) which is now operational in 69 major U.S. ports and waterways. NAIS enabled a sophisticated, mobile digital network for ship-to-ship, ship-to-shore, and ship-to-ATON communications. This network proved its worth in the aftermath of hurricanes Harvey, Mathew, and Irma when virtual ATON were energized long before physical ATON could be strategically positioned.

The USCG's role in these advancements would not have been possible without the dedicated professionals in their Research and Development Center (RDC) in New London. In my 40 years in the non-governmental R&D business I have never been more impressed by the breadth of technologies and focus on the customer as I have learned more and more about the USCG RDC. Founded in 1972, the USCG RDC has had a broad mission with respect to improving the safety and security of our waterways. From researching ecologically sensitive cables for anchoring buoys to the ocean floor to developing upper layer communication protocols for the existing Automated Identification System (AIS) Application Specific Message (ASM) set, RDC leverages its small workforce by cooperating with partners and engaging with relevant international standards associations.

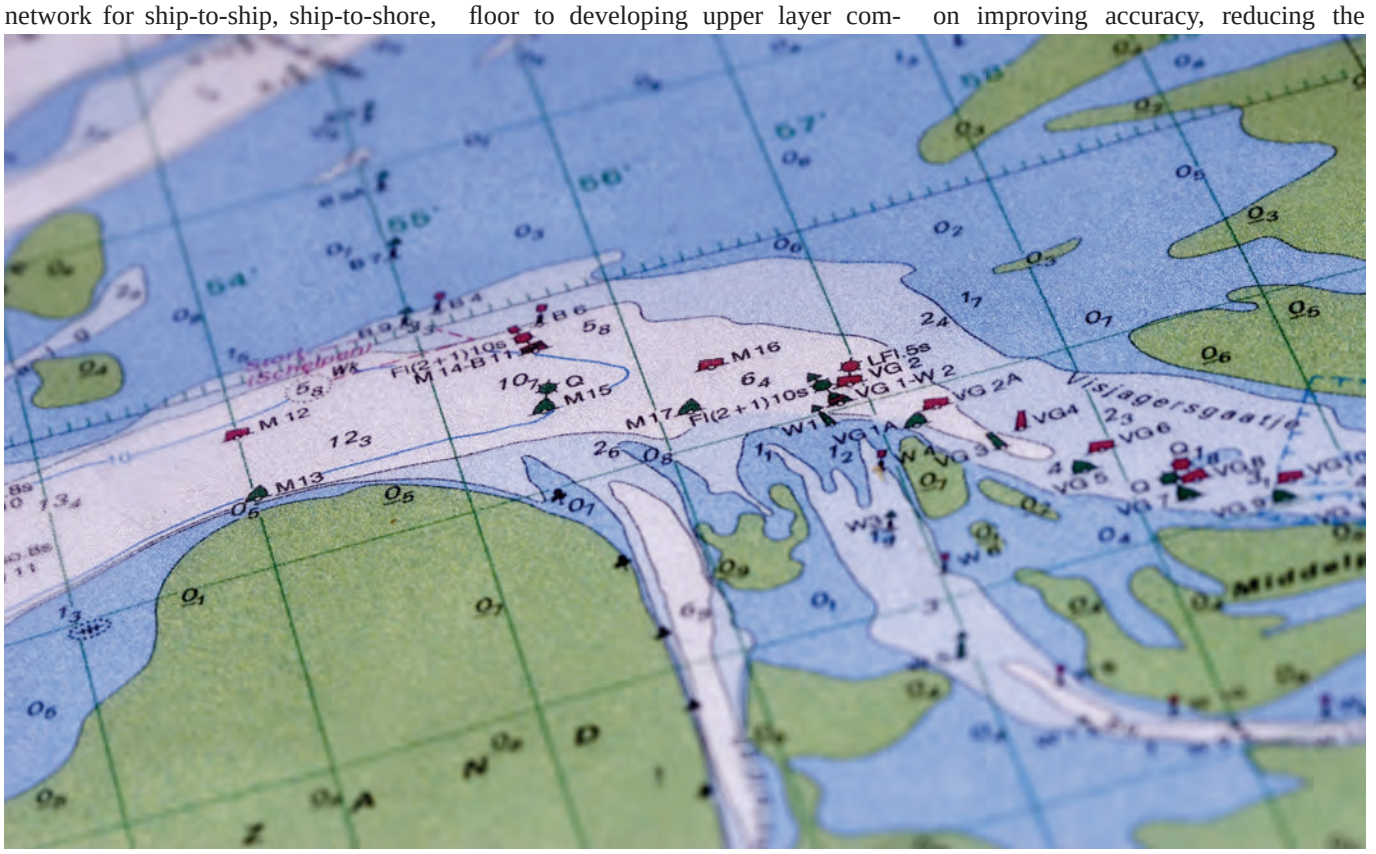
From the early days of RDC, projects were selected to help the Coast Guard perform its' mission with respect to buoy placement. Along with Aids to Navigation Information System (ATONIS) software, Differential Loran-C was developed and demonstrated as a positioning aid for setting buoys. Eventually these techniques were superseded by digital GPS. Over the years, also RDC did significant work regarding power and lighting capabilities, which are so vital for night time navigation. Even before there was AIS, RDC was working hard on improving accuracy, reducing the cost of setting, maintaining, and managing the vast collection of buoys in U.S. waterways. These efforts served as a foundation for the center's engagement in e-navigation.

The notion of e-Navigation, as defined by the International Maritime Organization (IMO), is only about a decade old, yet much progress is being made. The Committee on the Marine Transportation System (CMTS) is using the eNAV definition to develop its strategy for eNAV advancements in the U.S. Their goal is: "the harmonized collection, integration, exchange, presentation and analysis of maritime information onboard 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". RDC developed AIS architectures that are in alignment with those International Standards. To be more specific about one aspect of design, the RDC followed the International Telecommunications Union (ITU) recommendation:

a) that the use of a universal shipborne AIS allows efficient exchange of navigational data between ships and between ships and shore stations, thereby improving safety of navigation;

b) that although this system is intended to be used primarily for surveillance and safety of navigation purposes in ship to ship use, ship reporting and vessel traffic services (VTS) applications, it may also be used for other maritime safety related communications, provided that the primary functions are not impaired;

c) that this system is capable of expansion to accommodate future expansion



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in the number of users and diversification of applications, including vessels which are not subject to IMO AIS carriage requirements, aids to navigation, and search and rescue;

[To those unfamiliar with AIS, here is a simple primer. AIS is a data transmission system that uses VHF Channels 87 and 88 to transmit and receive data. These two channels are broken into 2,250 time slots where data is placed either by the ship or a shore station. Time slots are synchronized locally using the GPS timing function. A ship reserves a time slot using a protocol called self-organizing (time division multiple accessTDMA which is very efficient and reliable. Originally AIS was designed to send or receive only 22 messages related to the ship's identity, speed, direction, and other factors. With the development of ASM, the sky (or earth's surface) is the limit. In the U.S., numerous ASM have been tested. One such message is an environmental message that provides information on wind, tides, water levels, current, sea state, and other meteorological and hydrological data. Another is a waterways management message containing information that could be used for drawbridge and lock operations. A third ASM is a geographic notice that can define an area and provide information on precautions to be exercised in that area. Additional ASM are in draft form or currently being tested.]

RDC's work in this area has been far ranging. For example, a few years ago the RDC collaborated with the U.S. Army Corps of Engineers (USACE) to utilize the NAIS message set, routers, and servers to enable USACE to develop improved systems -- compatible with NAIS -- to enhance the safety and efficiency of operating inland locks. Several standard ASMs were defined and methods have been developed for message creation, routing, queuing, transmission and monitoring. Today, an AIS transmit architecture aligned with International standards has been developed to implement the efficient and robust transmission of these specific ASMs.

It is estimated that our nation's waterways enable over $4.6 trillion worth of economic activity at 360 plus ports. The Coast Guard has statutory responsibility to operate and maintain a system of maritime aids to facilitate navigation and to prevent disasters, collisions, and wrecks. To fulfill this mission, the Coast Guard operates over 53,000 aids throughout the United States, Hawaii, Alaska and other US locations such as Guam and Puerto Rico. However, this is not where the story ends. Today, recreational boaters can download a few smartphone apps to: identify and contact nearby vessels; alert the USCG of deficient ATON, navigational hazards, and environmental pollution; and, most importantly, navigate more safely and with greater security. As the software tools of e-Navigation become widely disseminated and third-party developers are able to build on the connectivity of NAIS assets, we will see significant advances in the role digital technologies play within the Maritime Transportation System

Consider the following scenario: You are sailing out of the Mayport, FL, Inlet and didn't realize that a 30,000-ton car carrier is creeping up on your stern at 7 knots. Your radar picked this up but you were too busy preparing to enter the sea. Fortunately, your son was down below playing Fortnight on his iPhone when he got alerted to the impending disaster. He tells dad and a catastrophe is averted. This is possible today because of the flexibility and standardization of the NAIS High-Level Data Link Control (HDLC) ASM messaging packets and the reliability and universality of its network infrastructure. Such an incident actually happened to a friend of mine (without the help of advanced AIS).

The collection of e-ATON, virtual ATON, Automatic Identification System/Application Specific Messages (AIS-ASM), Search and Rescue Transponder (SART), Satellite AIS (S-AIS) and more gives government, commercial, and private developers the tools to create new and exciting ways of improving vessel transport safety, security, efficiency, comfort, and enjoyment. The situation today is not unlike the power that was unleashed in the computer industry when open source and interoperability was more than a goal but a reality. This semester I will be encouraging my middle school STEM class to look for ways of allowing paddle boarders to advantageously use the AIS network. The USCG RDC continues to lead the way in not just predicting the future but making it happen.

[Author Note: The author would like to thank the many members of the USCG RDC staff with their help in writing this report. I especially want to note the contributions of Irene Gonin, and Lee Luft.]

Jeong-kie Lee

This month we caught up with Jeong-kie Lee, Chairman and CEO of the Korean Register and also the Chairman of the International Association of Classification Societies (IACS), for his insights on the dominant trends moving the maritime industry into the future.

BY GREG TRAUTHWEIN

Images: KRS

The maritime industry has been challenged, to say the least. Today, where do you see challenge? Where do you see opportunity?

The maritime industry is in a state of extreme upheaval, with private and public organizations having to deal with a wide range of ever changing, complicated issues in the realms of technology, regulation, finance, economy and competition, while facing little certainty about the future.

Increasingly challenging regulations governing SOx, NOx and CO2 emissions alongside the new BWMS obligations have added significantly to the technical burden weighing on shipping companies. As we all know, the IMO and some national regulators keep raising the bar, increasing the minimum requirements for their environmental standards. One of the main problems is that the industry does not have enough time to prepare for these regulatory demands. The maritime industry is becoming a place where only the fittest will survive.

Another significant challenge looking forward, is cyber security. As the shipping industry has become more and more digitalized, so cyber attacks on ships have increased. The shipping industry is the main artery of world trade, and so damage caused by cyber attacks can dramatically affect different industries across the global trade system and the impact is enormous.

KR sees the development of maritime autonomous surface ships (MASS) as one of the biggest opportunities facing the industry. MASS has potential to solve the problems the maritime industry has long faced; reducing human error, increasing the safety of ships and seafarers and improving environmental protection. Moreover, autonomous vessels will redefine the way the industry works and operates at sea, in ports, in shipyards and the onshore. But we are not there yet. Considerable collaboration is still needed between the regulators, shipyards, classification societies, shippers, insurers and industry to make autonomous vessels available at sea.

How has KR 'weathered the storm?' Specifically, how is the KR of 2018 most different from the KR of 2013? How is it still the same?

KR is a world-leading, technical advisor to the maritime industry, safeguarding life, property and the environment through the pursuit of excellence in its rules and standards. Founded in 1960 and becoming a member of the International

Association of Classification Societies (IACS) in 1988, KR works hard to ensure that customers receive an immediate, high quality service wherever they are.

Today, KR is authorized by 78 governments to act as a Recognized Organization and has expanded its international network to offer customers services, the most recent being in Portugal which opened this year. Reflecting this global growth, as of July 2018, KR's classed fleet stands at 68m GT and about one third of the society's gross tonnage is now owned by international shipowners.

Noting the rising importance of LNG as a marine fuel, KR has invested significant resources into the development of class technical services for global LNG partners. For example, KR has successfully completed the development of a standard design for each type of cargo containment system, targeting membrane tank LNG carriers of 170K working with the so-called 'BIG 3' shipyards (HHI, SHI and DSME). We provided full technical engineering services to build the world's first small-scale floating regasification unit in 2016. In addition, KR provided technical class services to the world's first LNG fueled bulk carrier built with high-manganese steel LNG fuel tanks in 2015.

To help our clients meet environmental regulations, in 2015, KR opened the world's first Greenship Equipment test certification center in Gunsan, Korea to provide evaluation, analysis and test of greenship equipment including marine diesel engines. In 2016, we significantly expanded our land-based test facilities for Ballast Water Management System (BWMS) to offer the largest capacity for BWMS testing to our international clients. In fact, KR was accepted as the very first Independent Laboratory in Asia to be accredited by the United States Coast Guard.

In 2017, KR opened a new ICT (information communications technology) Center to dramatically enhance the application of advanced information and ICT across the maritime and ship classification industries. Currently, significant R&D and specific projects in the fields of cyber security, autonomous vessels, big data, virtual reality and drones are being conducted. In addition, linked to the International Maritime Organization (IMO)'s e-Navigation strategy, the Korean Ministry of Oceans and Fisheries launched a SMART-Navigation project in 2016, which is scheduled to run from 2016-2020 with a budget of $114 million. As a key member of this SMART-Navigation project team, KR is conducting research and development into leading technologies as a basis for new international maritime standards.

Traditionally, most of KR's revenue has been generated from class surveys for commercial vessels. However, since 2013, KR's naval vessels business has grown considerably with revenue more than doubling. And this is not just the Republic of Korean Navy, KR now offers various class services to the Peruvian Navy, the Indonesian Navy and the Royal Thai Navy, and has done so for the last five years.

As a result of our efforts and achievements over the last five years, KR has solidified its international client base and the non-Korean KR-classed fleet size has increased substantially both with existing vessels and newbuilding.

In many respects this is a transcendent time in maritime history. What do you see as the three biggest trends that you feel will have the biggest impact on transport at sea in for the coming generation?

As already mentioned earlier, meeting the requirements of forthcoming environmental regulations, protecting the industry against ever-growing cyber security risks and the development of MASS are the three trends that will have the biggest impact on transport at sea in for the coming generations.

These three trends offer the greatest possibilities to reshape how we work, what we manufacture, how we train seafarers, to influence academic fields, legislation frames, the insurance industry and almost all areas of the maritime industry. Each of these factors will have a different but very significant impact on the industry over time.

But overall, KR does believe that without doubt, the ships of 2030 will be more robust, more automated, consume less fuel and emit less pollutants than the ships of today.

KR has already begun to lead the industry on each of these three trends. The work scope of KR's ICT center embraces each one and we are already delivering specific technical and engineering services on each of these subjects to our clients. KR has been carrying out numerous projects with the Korean government, universities and maritime organizations to prepare for a cleaner, digitally safer and increasingly digitalized maritime industry. For example, KR has undertaken extensive technological research to develop and provide comprehensive cyber security services. We created our own specialist Cyber Security Task Force Team in 2016 and launched our cyber security guidelines in the same year. KR now provides technical cyber security consultancy services to U.K. based clients which include a comprehensive company-wide risk assessment to establish an effective, management system for any company's ship cyber security, helping to protect against this growing threat.

In looking at digitalization we obviously focus on the ships, the fleets and fleet operation. But looking at this through the KR lens, how is the 'digital revolution' impacting how KR conducts its own business, in the field, in the office?

The digital revolution is impacting our business in many ways.

Firstly, KR is now using drones on a regular basis to conduct ship inspections, offering the service from its network of offices. The surveys are conducted onboard in and around ships in many of the high risk and difficult to access areas. Using unmanned aerial vehicles or underwater remotely operated vehicle drones, the drones can easily and safely explore confined spaces with restricted access, poor ventilation or environmental high-risk areas, or parts of the ship which would require scaffolding for surveyor access.

Developed specifically for bulk carriers' cargo holds and the ballast tanks in barges, KR is using the drones for close-up surveys too, to inspect detailed struc-

tural components. Already an important part of the decision making and assessment process, the drones provide clear visual data for analysis, which can be reviewed by KR's inspectors in real time, complimenting their traditional skills.

Secondly, KR has been developing various VR based application systems since 2014, including a ship inspection training simulator and a ship crew safety training simulator and using digital 3D replicas of the relevant ship, and is continuing to expand its application range. The ship inspector training simulator was developed to allow a ship inspector to experience and increase their knowledge of the rules, safety regulations, and for senior surveyors to test their knowledge of different ship types in a virtual ship environment. The inspector can check that the information matches the real ship shape using text, images and video, and two or more surveyors can simultaneously participate in the virtual reality simulation to undertake virtual 'On The Job Training'. This VR-based Vessel Inspector Training Simulator allows the inspector to experience a sense of realism that is almost identical to the actual site, without any limitations in time or place. This can significantly enhance the safety awareness of the inspector and improve his competence by identifying and allowing him to experience risk factors in the field, in advance.

Lastly, KR has been working to develop a 3D model-based design approval system since 2017, all with the aim of supporting enhanced productivity in the shipyards and providing a more accurate and intuitive review of ship structure for the classification societies. Traditionally, the design approval of a ship by a classification society has been a paper-based process, involving the exchange of numerous large-format drawings between the shipyard and the classification society. Now KR has developed a 3D model-based design approval viewer which supports multiple platforms such as PC (MS Windows, linux) or mobile devices such as tablet or smartphone (Android, iOS). This means that the same 3D model and corresponding comments from the plan approval surveyor can be accessed on the mobile devices of the field surveyors in the shipyard. In addition, the 3D model, its associated information and engineering data can now be managed through the ship's lifecycle as the digital twin. A web browser-based 3D model viewer is now under development, which will allow the 3D model to be shared without requiring a file transfer, thereby protecting the customer's intellectual property.

How is KR investing today to prepare for its tomorrow?

To answer this question, we must think about the role and responsibilities of classification society in the future. The traditional role of class providing an important contribution to the maritime industry through technical support, compliance verification and R&D will be unchanged. However, what will change are the demands from the industry, as industry responds and adapts to the challenges of the fourth industrial revolution.

Moving forward, KR will do its utmost to remain a reliable expert classification partner to the maritime industry. As a class, KR will invest in enhancing its core competencies by developing the quality

of its surveyors, its classification rules and standards and its R&D capabilities. While focusing on this, KR will also endeavor to anticipate and meet the growing demands from the industry in relation to the fourth industrial revolution. For example, KR's ICT Center will focus on finding ways to apply big data to operate vessels more efficiently, to identify safe navigation routes in real time, to understand accident statistics and manage risk better and to predict ocean characteristics, while using CBM (condition based monitoring and maintenance) to alert vessels to device failure. The ICT Center is also developing new software test standards in line with ISO 25000, to verify the quality of IT software and will be able to offer its clients new comprehensive software test services shortly.

In addition to the fourth industrial revolution, KR has been investing in alternative energy sources for a cleaner environment. KR has been conducting R&D to develop hydrogen as a marine fuel, with further research into the transportation technology for liquid hydrogen by ships. For wind energy, KR has provided wind turbine certification services including type certification, component certification and project certification, and KR has also developed technical guidelines of onshore and offshore wind turbine design.

How will "class" look, act and evolve in the coming decade?

The purpose of a Classification Society has always been to provide classification and statutory services and to help the maritime industry and regulatory bodies to ensure maritime safety and prevent pollution. These objectives will remain uppermost for all classification societies but the way these objectives are delivered will change significantly as a result of digitalization. Digitalization especially Big Data is expected to influence the scope and/or frequency of class surveys in the yards, ports and even in the office and the services that Class has traditionally offered to industry will be more digital-based.

Provide some insight on the value of IACS in today's maritime world?

The traditional role of IACS, which is to make a unique contribution to international shipping through maritime safety and regulation by providing technical support, compliance verification and research and development, has stood the test of time and will continue to do so long into the future.

However, with the fourth industrial revolution becoming more and more embedded in the maritime industry, new technologies and ideas such as autonomous ships and digitalization are increasingly driving innovation. With the introduction of new technology such as Big Data, Remote Moni-

toring/Diagnosis (RMD) and Condition Based Inspecting/Maintenance (CBM), the industry is looking to IACS and its member societies to help them meet these new challenges.

IACS has investigated the implications of new technology on the survey regime and is developing new and amending existing, technical requirements for Condition Monitoring and Condition Based Maintenance schemes. IACS is examining instances where the condition monitoring results are used to influence the scope and/or frequency of Class survey for machinery components and systems, and the requirements for software, onboard working, documentation, personnel, approval, as well as the survey application for applying the scheme, and survey/audit to maintain the scheme.

As you now lead this international organization, what is your agenda for IACS in the coming 24 months? What do you hope to achieve?

Delivering on the core elements of quality, transparency and technical leadership will be key to my chairmanship of IACS.

Specifically, this means rolling out the series of Recommendations on Cyber Safety, implementing the strengthened quality benchmarking criteria and continuing to increase IACS transparency and clarity through the publication of documents such as the Annual Review, and a series of position papers on pressing issues such as the 2020 Global Sulphur Cap and ballast water management.

In addition, during my chairmanship, IACS will closely monitor the work of the IMO on autonomous vessels and GHG (greenhouse gases) to ensure that the association is able to make meaningful contributions to the IMO and the industry on these key issues which will shape the future of international shipping.

Liquefaction and Lost Bulk Carriers

Is a Design Change Warranted to Make Cargo Holds Smaller?

About the Author

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A shocking number of bulk carriers (as well as a few OBOs – ore/bulk/oil carriers) have been suddenly and catastrophically lost at sea in the last 30 years. Following are the names of some of those vessels, in alphabetical order: Asian Forest (2009); Black Rose(2009); Bulk Jupiter (2015); Derbyshire (1980); Emerald Star (2017); Harita Bauxite (2013); Hong Wei (2010); Hui Long (2005); Jian Fu Star (2010); Nasco Diamond (2010); Stella Daisy (2017); Sun Spirits (2012); Trans Summer (2013); and Vinalines Queen (2011). Several hundred sailors lost their lives in these casualties.

The known or suspected cause of these tragic losses has been liquefaction of cargo. In all but one case, the lost ship was carrying one of three cargoes: iron ore fines; nickel ore, or bauxite. Hui Long was carrying a cargo of fluorspar mineral. These are all classified as solid bulk cargoes – granular materials loaded directly into a ship's cargo holds. These cargoes actually consist of two phases because invariably there is water present within the granular material. The water may have accumulated during mining and processing, during storage (generally in piles on the ground exposed to the weather) while awaiting loading on the ship; or during or immediately after loading if precipitation occurs. During the time that the ship is at the pier or transiting through calm water, the cargo is quite stable.

In an open seaway and particularly during heavy weather, the cargo becomes subject to significant stresses. Those stresses lead to an increase in the water pressure. When the water pressure exceeds the pressure of the granular cargo, the mass can liquefy. This liquefaction can start in a small portion of the cargo and rapidly spread, resulting in a sudden shifting of the entire mass. When this occurs on a modern bulk carrier with huge cargo hulls, the ship is subject to severe listing. If not corrected quickly, the ship can capsize, often so fast that a distress signal is not sent.

The International Maritime Organization (IMO), ship insurers, and trade associations (such as INTERCARGO) have been working for a number of years to minimize the risks involved in the transport of these solid bulk cargoes. The IMO issued circulars and resolutions and has amended the Safety of Life at Sea (SOLAS) Convention to institute mandatory measures regarding such shipments.

The IMO initially adopted the Code of Safe Practice for Solid Bulk Cargoes (BC Code) in 1979 as recommended guidance for ship owners and masters. In 2008, it was replaced by the mandatory International Maritime Solid Bulk Cargoes Code (IMSBC Code). The aim of the IMSBC Code is to facilitate the safe stowage and shipment of solid bulk cargoes by providing information on the dangers associated with the shipment of certain types of cargo and instructions on the appropriate procedures to be adopted.

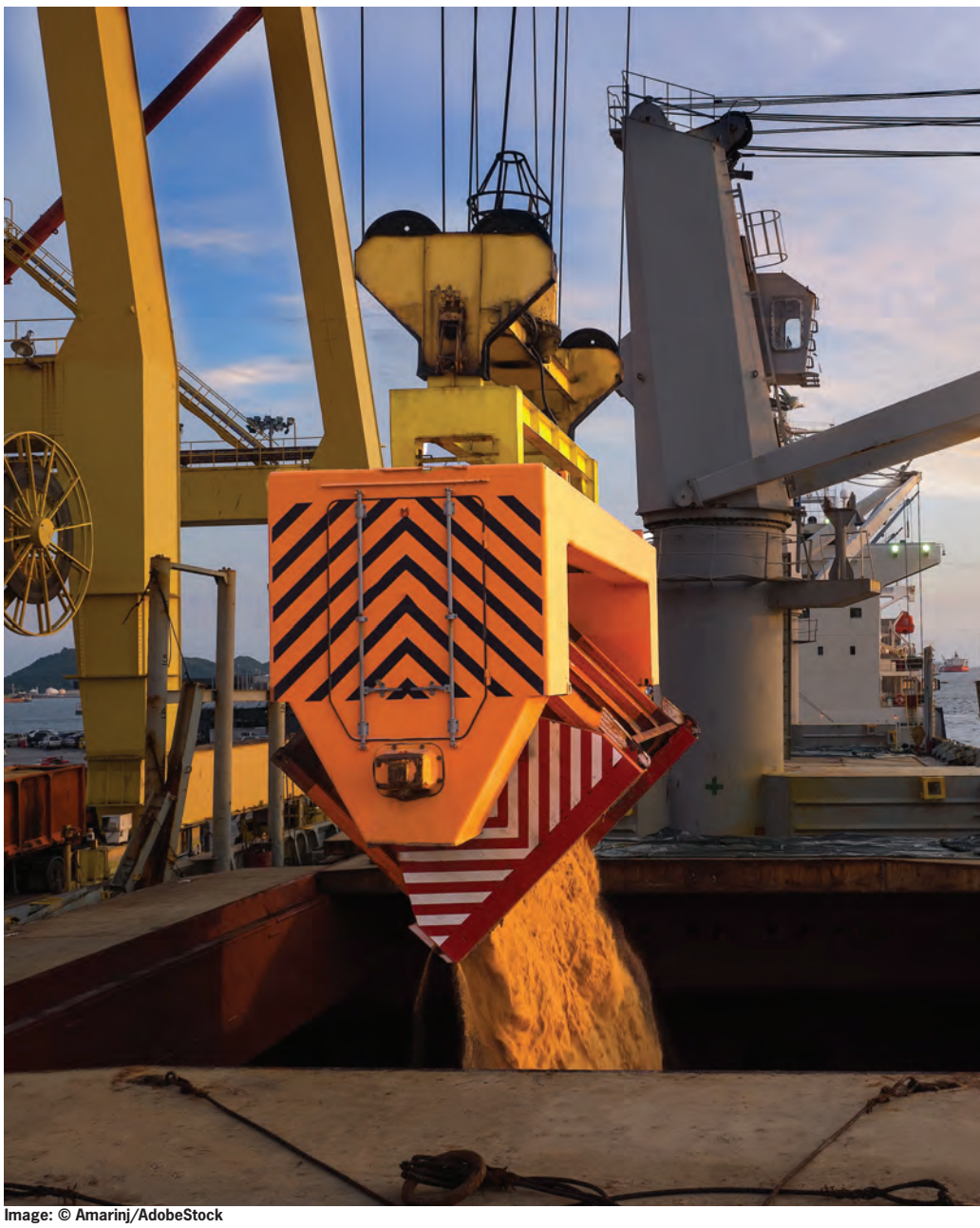


Image: © Amarinj/AdobeStock

Bulk carriers continue to be lost at sea despite these efforts. One of the problems is that while the IMSBC Code prohibits the master from loading bulk cargoes the Transportable Moisture Limit (TML) and Moisture Content (MC) of which exceed certain limits, the certification of the TML and MC, as well as the exact identification of the cargo are provided by the shipper. The master has minimal capability to challenge those certifications. Some experts contend that the current IMO approach is too simplistic. Liquefaction potential depends not just on how much moisture is in a bulk cargo, but also on other characteristics, such as particle size distribution, the ratio of the volume of solid particles to water, and the relative density of the cargo, as well as the method of loading and the motions of the ship during the voyage. Some of these latter factors may be beyond the capability of the master to determine.

There is, though, another approach that can be taken to minimize the risk of catastrophic liquefaction of solid bulk cargoes. A smaller cargo hold would mean that any liquefaction of the cargo in that hold would have less impact on the stability of the ship. Rather than reduce the overall size of the vessel, a longitudinal bulkhead could be installed to divide each current cargo hold, which now extends the breadth of the ship from port to starboard, into two smaller holds. This may not be practical for existing bulk carriers, but would not present a technological challenge for new construction. This would be the bulker equivalent of the double hull that has proven so successful for tankers. While construction costs would be marginally higher and the loading and discharge of cargo would be somewhat slower, compare that with the ships, cargoes, and lives that would be saved.

2018 Maritime Risk Symposium – Energy and Maritime Risk

DiRenzo III

Moss

By Dr Joe DiRenzo III and Craig Moss

ENERGY.

It seems that energy touches every aspect of our lives from heating our homes to ensuring that fresh produce is available at grocery stores. It powers our cars and allows industry to move products around the world. The connection between energy and risk to the maritime environment has been a growing area of discussion, research and analysis.

The United Kingdom's Royal Navy, within its Joint Doctrine Publication (JDOP 0-10) 5th edition UK Maritime Power, captured this issue superbly: "Fossil fuels and minerals are an important resource in the maritime environment. New deposits of oil and gas, as well as mineral wealth, are discovered under the seabed each year, and improvements in technology will facilitate future exploitation. Access to these, whether found on the continental shelf or within an exclusive economic zone, is likely to be contentious. For example, Russia, Norway and Canada have all laid competing claims to large areas of the resource-rich Arctic seabed." All of these issues and so many more drive the discussion of the intersection between energy and maritime risk.

In November the 2018 Maritime Risk Symposium will add another layer to the discussion of this critical international subject. The event will be held Nov. 15-16 at Oak Ridge National Laboratory in Oak Ridge, Tennessee. This event, which is co-sponsored by Oak Ridge National Laboratory, the U.S. Coast Guard, and National Academies of Sciences, Engineering, and Medicine Transportation Research Board will bring together government, industry and academic leaders – both domestic and international – to explore the fast-approaching new energy landscape for the maritime transportation system.

This event is timely for a number of reasons. Recognizing the global trend toward decarbonizing the fuel mix, the symposium will address issues facing us as consumers and transporters and producers of energy, as well as our maritime resilience and environmental stewardship. Outcomes will inform and guide developing options for policy and planning, developing human capital, and recommending research and development to ensure we are prepared for this energy evolution and the new risks and opportunities it brings.

What are the specific goals of the event?

- *Develop a better understanding of how energy is evolving in the maritime industry and how these developments will impact maritime operations.*
- *In the face of this future energy landscape, explore sufficiency in policy, regulation, human capital, marine spatial planning, response, salvage and other critical issues to ensure an efficient, safe, secure and resilient marine transportation system.*
- *Identify research and development needs and potential academic focus areas related to how the maritime transportation system should respond to the emerging energy landscape.*

These discussions are necessary for at least two reasons. First, as technology develops – from alternative energy technologies and estimates of energy availability to ways to extract and transport it – there will be a need to explore the interdependencies on components of the system. Another big area is developing academically rigorous research questions that will provide students and academics alike an understanding of areas of research that are truly important … and need further study.

Major agenda themes for the 2018 event

Advancing technologies are rapidly changing how energy is moved through and used by the maritime transportation system. Extraction technologies have fueled the shale gas boom; advancements in renewable energy are making offshore options economically viable for hydrokinetic, wind and solar technologies; and environmental regulations are forcing shipping and ports to explore new energy approaches. To prepare for this rapidly evolving energy environment, the symposium will explore these themes among others:

- **Project Evergreen.** This is a U.S. Coast Guard-inspired event that will look at the global energy evolution and the associated risks for the maritime transportation system 20 years into the future. The Coast Guard conducts Evergreen events to position the service to navigate emerging strategic challenges and seize opportunities. Evergreen events are designed to develop insights into future trends, discontinuities and strategic surprises, and communicate insights to decision makers for informed policy planning. The keynote for the Evergreen portion will be presented by Retired USCG Rear Adm. Kevin Cook
- **An Evolving Energy Environment in the Maritime Industry.** This session will assess the impact of evolving global trends in energy use on the maritime transportation system. As energy production and use evolves in the U.S., so does its transport and uses within the marine industry. The boom in domestic liquefied natural gas (LNG) production as well as environmental standards are causing vessels to convert from bunker oils to LNG for fuel. The transition to renewable energy is leading to offshore wind farms that encroach on shipping routes and fishing grounds. The diminishing use of coal and the growth in domestic oil production is altering marine transportation patterns, spurring growth in petrochemical facilities along waterfronts, and producing heavier oils that challenge traditional spill removal technologies. These changes will dramatically affect domestic and international maritime commerce as well as government oversight, security and regulatory actions. Panelists will provide industry, government and global perspectives to create a shared understanding of these emerging challenges vital to ensuring a smooth and prosperous transition into the new energy paradigm. The moderator for this panel is Chris Doane of Coast Guard Atlantic Area.
- **Maritime as a Consumer, Transporter and Producer of Energy.** This panel will focus on the understanding constraints on energy flow and how best to keep supplies moving. Even the slightest disruption of energy with the maritime transportation system can have a significant domino effect on the transfer of goods and services around the world. Energy, the driving force of society, has reached new landmarks with new fuels and their handling requirements. Energy and fuel sources such as hydrogen fuels cells, LNG, hybrid electric, small modular reactors, wind farms (shore and offshore) and solar panels are all relatively new. Their uses for propulsion, transportation and input to a grid are complicated challenges to the maritime industry and society at large. The maritime industry is expected to use and move them safely and securely from inception to maintenance. Ports and localities are expected to prepare safe and secure storage and connector facilities with the support of their constituency and the public. These challenges and overcoming biases require dissemination of information, spread knowledge, provide training, planning, and regulations, to name a few. The Maritime as a Consumer, Transporter and Producer of Energy panel addresses these diverse topics and others that challenge the industry and society. The moderator for this panel is Capt. Eric Johansson, Maritime College, State University of New York, who is the vice chairman of the 2018 event.
- **Risk Drivers to Energy in the Maritime Environment.** Defining and quantifying risk is one of the most difficult tasks in an evolving dynamic environment. As energy technologies advance, new opportunities emerge in the maritime environment. New sources of energy production become available.

Distribution channels for the import and export of energy resources adapt. Ports, intermodal carriers and vessel operators employ new processes and equipment to improve the efficiency of supply chains. Each of these factors drive risks in the maritime environment; sometimes creating new vulnerabilities and other times enabling new sources of resilience. Though the seeds of drivers of future risk can be seen in today's technology advances and private sector investment decisions, the risks may not be actualized for several years. This panel explores drivers in energy resources and production that have in the past affected marine systems and emerging drivers that could create new opportunities and place new pressures on the maritime environment. It then will examine how these drivers are accounted for in marine planning and the implications of such changes for the maritime workforce to harness opportunities and mitigate risks from these drivers. Finally, the panel will examine ways that the maritime industry can identify signals in today's trends to recognize the next energy breakthrough. The symposium welcomes back Dr. Henry Willis of the RAND Corporation. Dr. Willis is considered one of the top experts on maritime risk in the world.

➢ **Maritime Resilience with a New Energy Mix.** The maritime transportation system carries the vast majority of trade, and its ongoing operation is vital to our national and global economic welfare. Service interruptions at a port, canal or other waterway can cause ripple effects in transport logistics that have serious economic consequences. Energy plays an important role in ensuring continuity of operations both on land and at sea, and all stakeholders in the maritime environment have strong incentives to find new ways that energy can be used to improve their operational resilience to potential disruptions, either natural or man-made. This panel explores how we ensure that our maritime infrastructure is always able to deliver the services that the nation demands, with emphasis on the way in which changes in our use of energy create both challenges and opportunities for doing so. The moderator is Dave Alderson, Associate Professor of Operations Research and Director of the Center for Infrastructure Defense Naval Postgraduate School. Dr. Alderson's research focuses on the function and operation of critical infrastructures, with particular emphasis on how to invest limited resources to ensure efficient and resilient performance in the face of accidents, failures, natural disasters or deliberate attacks.

➢ **Environmental Stewardship: Are We Prepared for Mishaps in a New Maritime Energy Mix?** The panel looks at safeguarding the marine environment as energy evolves. In response to more stringent vessel air emission regulations, the maritime industry has been investigating the use of alternative and non-conventional fuels, fuel blends and alternative technologies that meet or exceed the new standards. Fuels being investigated range from heavy and distillate blends to biofuels to liquefied natural gas. Promising technologies being researched include fuel cells and batteries. Because operational profiles vary widely within industry, there is no single fuel choice or technology that will meet the needs of all vessels. Therefore, it is expected that several variations will be used dependent upon ship specifics, cost and availability. This panel will focus on the use, environmental risk and uncertainties of alternative fuels and technologies. Panel presentations will range from an in-depth look at current and projected fuel types to identification of spill or release hazards and applicability of existing regulations. The panel will also include an industry perspective on the operational feasibility of these fuels. The panel is led by Dan Yuska from the Department of Transportation's Maritime Administration.

The symposium has also brought together three nationally recognized leaders as keynotes that bring a diverse perspective to the event: Rear Adm. Paul Thomas, Commander of the Eighth Coast Guard District; Bruce Walker, Assistant Secretary, Office of Electricity; and Dick Balzano, Deputy Maritime Administrator of Maritime Administration (MARAD). Retired USCG Vice Adm. Rob Parker returns for his fourth year as the event's master of ceremonies and senior mentor.

The Maritime Risk Symposium will also feature a poster contest for undergraduate, graduate and doctoral students. The poster can focus on research that is being conducted in any aspect of maritime energy-related subjects. Students should proceed to this web site **https://easychair.org/account/signin.cgi?key=77787658.Wdtx4IDOB3RecDhY** to create an Easy Chair account and submit your work.

The web site for the 2018 Maritime Risk Symposium is **https://mrs2018.ornl.gov/**

MAN ES:

2020 is just around the Corner

Images: ©MAN ES

MAN introduces New MAN B&W ME-LGIP Engine for LPG use

By Peter Pospiech

The sulfur emission control areas (SECAs) in place in North-America and Northern Europe, in combination with the upcoming global 0.5% limit on sulfur in 2020 (or 2025) and similar EU limits in 2020, call for alternative fuels as a means for compliance. Several alternative fuels are available and, at the same time, new fuel oil products with very low sulfur content have been introduced.

In this respect, the ability of the new MAN ME-LGIP engine to run on LPG, which is a sulfur-free fuel, offers great potential for compliant ship operation within SECA zones.

The use of LPG as the fuel in MAN B&W two-stroke engines will reduce the C02 emission by up to 13%, when compared to MDO and up to 18% when compared to HFO. As an additional feature, the LPG engine has great potential for being a solution to handle the volatile organic compound (VOC) issue in shuttle tankers and other crude oil carriers as the engine holds novel options for burning the liquid volatile organic compound (LVOC) of the VOC. The engine can burn any mixtures of propane and butane, and furthermore, the mixture can contain significant amounts of ethane. All heavier hydrocarbons normally contained in the LVOC can also be used.

Both gas carriers and container ships would be potential customers for the multi-gas engine. René Sejer Laursen, promotion manager, dual-fuel engines, MAN Energy Solutions noted that gas carriers are already installing tanks capable of holding LPG, LNG and ethane (although not mixed together), and an engine that could burn all these fuels would be a considerable advantage.

"The potential for containerships to use the fuel is also considerable", Laursen said. He argued that operators had shied away from LNG because it often ties them to one supplier. The ability to use several fuels would give them a competitive advantage by allowing them to select the cheapest fuel at a given port, as well as ensuring compatible fuels are available at a wider selection of ports.

The Introductory Event

Against this background MAN Energy Solutions has revealed its latest two-stroke engine type, a dual-fuel MAN B&W ME-LGIP engine designed for LPG running, at a ceremony in Copenhagen on 3rd of September attended by its Chief Sales Officer, Wayne Jones, along with a large crowd of customers and business partners. The event was hosted by MAN Energy Solutions' Thomas Knudsen, Head of the Two-Stroke business unit, and Bjarne Foldager, Vice President Sales & Promotion – Two-Stroke business unit.

Bjarne Foldager said: "Interest in using LPG as a fuel, within and outside of the LPG carrier segment, is growing due to its sulfur-free character, widespread availability and ease of bunkering. In gas mode, the ME-LGIP engine operates on just 3% pilot oil and down to 10% load. Ultimately, we expect the engine to operate without the need for pilot oil."

MAN Energy Solutions expects a strong demand for the ME-LGIP engine from very large gas carriers (VLGCs) and coastal vessels from its introduction.

Foldager added: "The ME-LGIP can also burn liquid volatile organic compounds, a deliberate move on our part since the IMO will inevitably turn its focus towards the reduction of volatile organic compounds in the future. Accordingly, we view the ME-LGIP as also ideally suited to the propulsion of shuttle tankers and very large crude carriers."

The Diesel principle provides the ME-LGIP engine with high operational stability and efficiency, including during load changes and fuel change-over, while defining properties such as a stable change-over from one fuel type to another with no fuel-penalties are maintained. The negligible gas slip of the ME-LGIP engine makes it the most environmentally friendly, two-stroke technology available.

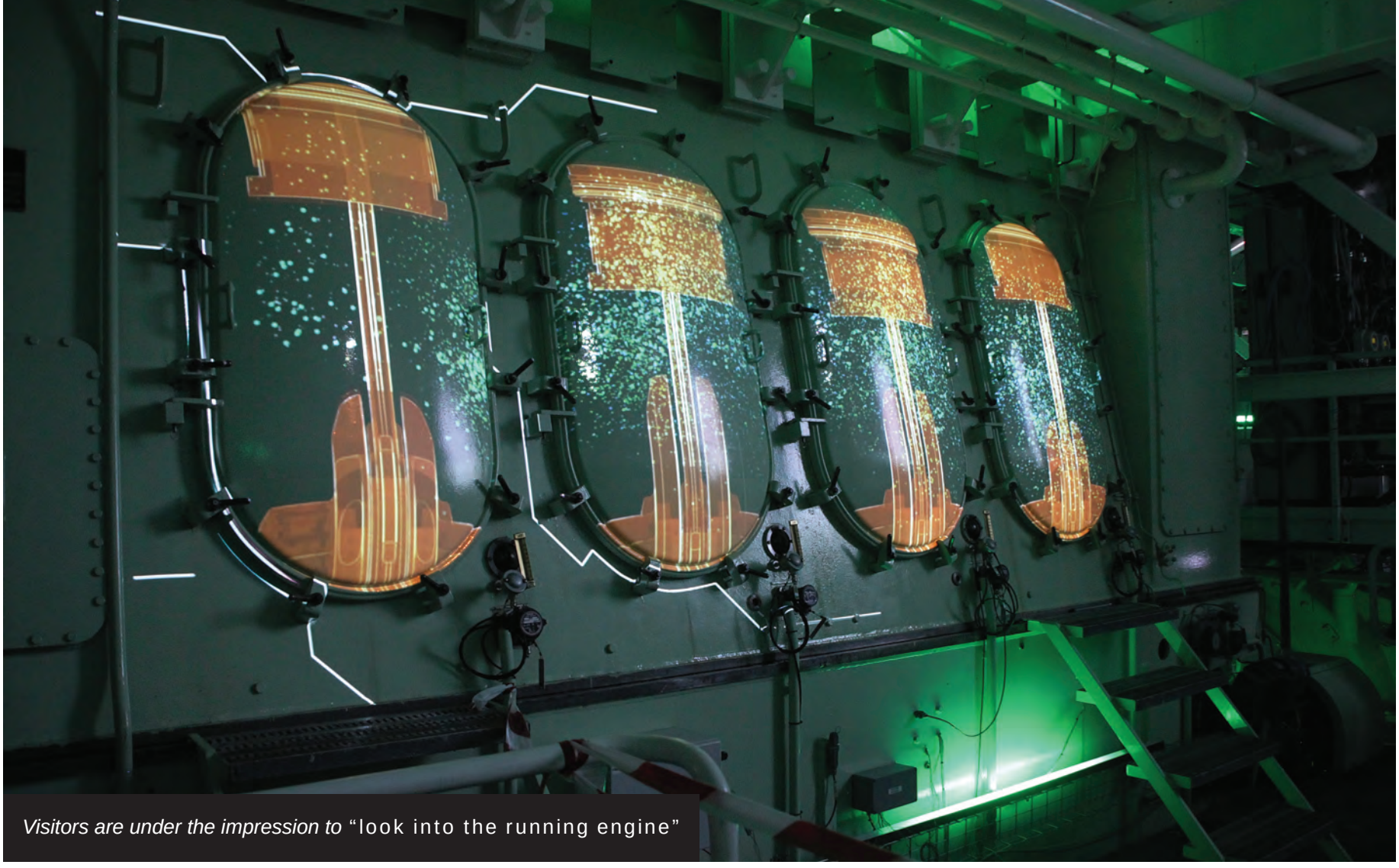
MAN ES also reports that the ME-LGIP engine has experienced an up to 18% reduction in CO2 and circa 90% reduction in particulate matter when running on LPG, compared with HFO.

One Engine Fits All

As has been explained during the introductory event in Copenhagen the MAN B&W ME-LGIP is the only liquid gas injection dual-fuel engine on the market, allowing to switch between conventional HFO, MGO and LPG fuels with no loss to performance. Not only does this help to maximize ROI, but with zero sulfur in LPG and 13% less CO2 from LPG fuel, ship owner stay comfortably within emissions limits.

The compact liquid gas injection system means the MAN B&W ME-LGIP could also be an ideal retrofit solution for existing fleets. The technology can be applied to all types of ships with an ME-C engine of bore size equal to or bigger than 500 mm. LPG gas carries are likely retrofit candidates.

Furthermore, the ME-LGIP engine is



Visitors are under the impression to "look into the running engine"

Images: ©MAN ES

flexible with regard to LPG composition and finds even LPG qualities containing significant amounts of ethane acceptable.

The ME-LGI (-Liquid Gas Injection) concept can be applied to all MAN Energy Solutions low-speed engines from 500-bore and up, either ordered as an original unit or through retrofitting.

The primary characteristics of ME-LGIP engines include:

The engine works according to the two-stroke cycle and comes with numbers of cylinders from 5 to 12 depending on bore size (bore: 500 mm to 950 mm); whereby the stroke/bore ratio is: 3.6 to 5.0.

With this the specified maximum continuous power range is of 5,350 kW to 82,440 kW.

The engine features:

* a low-pressure supply system;

• a fuel-injection system similar to that most recently developed for MAN ES conventional MDO/HFO engines – the FBIV (Fuel Booster Injection Valve): this innovative fuel booster, specially developed for the ME-LGI engine, ensures that a low-pressure fuel-gas supply system can be employed, significantly reducing first-time costs and increasing reliability,

• an injection pressure of 500-600 bar

• the ability to handle low-sulfur/low-flashpoint fuel types: methane, methanol, ethanol, LPG, and dimethylether (DME).

• Turbocharging system

• High efficiency constant pressure turbocharging systems with MAN, ABB or MHI turbochargers as standard

• Engine automation and control

• In-house developed gas safety and control system

• Fuel oil system

• Common injection system for pilot oil and for main injection

• Gas system

• LPG injection by fuel booster injection valves (FBIV)

According to MAN ES it comes without saying that the new MAN B&W ME-LGIP engine fulfills the following exhaust regulations:

* IMO Tier II and also IMO Tier III (with SCR, EGR or EcoEGR*). (*): for improved efficiency when operating in Tier II mode.)

Summary

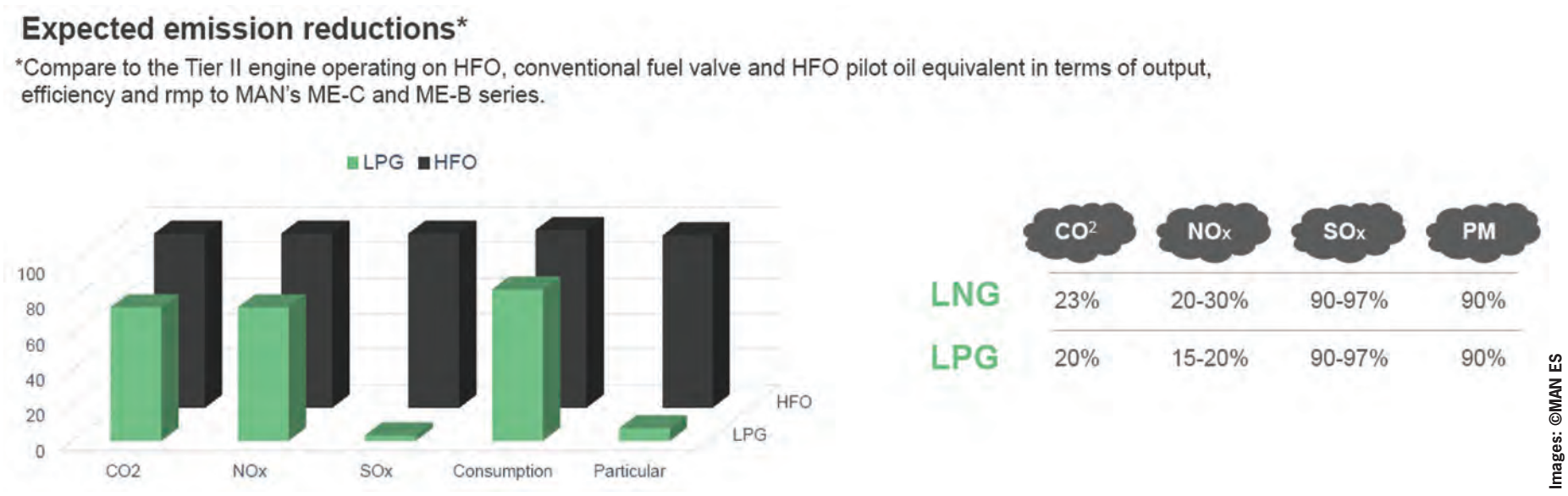
The ME-LGI came about due to interest from the shipping world in operating on alternatives to HFO. Methane, Methanol and LPG carriers have already operated at sea for many years and many more LPG tankers are currently being built as the global LPG infrastructure grows. With a viable, convenient and comparatively cheap fuel already onboard, it makes sense to use a fraction of the cargo to power the vessel with an important, side-benefit being its positive, environmental performance.

* The ME-LGIP engine operates with the same efficiency as the ME-C engine

* The ME-LGIP engine will consume LPG as main fuel and uses HFO as pilot oil

* Seamless change over from gas to fuel and vice versa

* Possible to run on any gas/fuel mix, fuel flexibility



Images: ©MAN ES

Wayne Jones *MAN ES*, Pontus Berg *BW LPG Ltd*, Rene Sejer Laursen *MAN ES*, Lars Juliussen *MAN ES*

Images: ©MAN ES

Image: TOTE

TOTE & LNG's *'Field of Dreams'*

Build it and they will come mentality serves TOTE well on 'world first' LNG Containerships

As the marine industry collectively struggles to find solutions to the mounting mandates to cut emissions, U.S. owner TOTE, which broke ground three years ago with the world's first LNG-fueled containership, has more than 36 months experience operating almost exclusively on LNG. To date it has been a rousing success.

By Greg Trauthwein

As environmental mandates for ships continue to get stricter, particularly with the new fuel rules and drastic reduction in sulfur emissions coming in 2020 and with 'decarbonization' now on the agenda courtesy of mandate from the International Maritime Organization, many vessel owners are at a crossroads as to the appropriate solution for both the environment and the bottom line.

Peter Keller, Executive Vice President, TOTE, who was pivotal in bringing from drawing board to service the world's first LNG-fueled containership, sees the solution dead ahead: LNG.

"There are two things that are important: First, we all know that environmental regulation will become more stringent. LNG at that time (in 2012/13, when the decision was being made) – and still today – is the only viable, scalable, safe option," said Keller. "Since Jones Act ships have a 35-year (or more) life span, projecting requirements and building a ship to that was a big concern. These ships operate 51 weeks per year, they have to make the voyages. We don't have time to mess around with big retrofits."

The second factor was the cost of the fuel: both the cost of LNG and uncertainty over the long-term price trajectory of other compliant fuels.

"When you look at LNG and contract for it on a long-term basis, the price of LNG is stable over time," said Keller. "We inspired the building of liquefaction plants near our facilities, both in Tacoma and in Jacksonville. So we have a relatively fixed reservation fee, and a fixed cost on a barge, so the only fluctuation in our fuel cost is the Henry Hub, which is minimal. As a business person I have a pretty good idea of my fuel costs for the next 10 years. When you look at where the price of compliant fuel is going … is it going to be a 40% differential to crude, 50%? Who knows. I do know that my cost of LNG will be relatively stable."

While the cost of LNG is stable, there

are inherently additional CAPEX and OPEX on the ship itself. "With LNG you have a lot more sensors, you have a lot more safety equipment, a lot more alarms, a lot more IOs … our barge for example has 2500 IOs … in a 2200 cu. m. barge," said Keller. But over the projected life of the ship, Keller said the case for LNG was strong and clear.

EXPERIENCE ON THE SHIPS

'Isla Bella' and 'Perla del Caribe' are 3,100-TEU sister ships that serve the route between Jacksonville, Fla., and San Juan, Puerto Rico, propelled by the first ME-GI dual-fuel engines produced by MAN Energy Solutions.

"I don't think most ship owners understand that this LNG technology has been running as long as it has in a purely commercial environment," said Keller. "The LNG fueled ME-GI engine represents TOTE's commitment to environmental stewardship. Importantly, LNG as a fuel eliminates SOx and particulate matter, significantly reduces NOx and –increasingly importantly – contributes to the reduction of greenhouse gases. This gives us the ability to move forward aggressively in terms of air quality which is especially important in the pristine areas of the Caribbean and Florida where our vessels operate."

Keller said that the industry has two environmental problems: air quality and decarbonization. Regarding air quality, his answer is simple: "we've been working on it for decades, and today we have the answer: Liquefied Natural Gas."

Decarbonization is not so simple.

"LNG will contribute to this by 15-25%, and that's good, that's a step toward the IMO targets of 2030 and 2050," said Keller. "Does it get us there? No. But it gets us going in the right direction. We have to be very careful that we don't allow one problem to supersede the other. We have to do both, we have to clean up the air; on the other side there is an issue with global warming, and we have to address that."

"We've had three years of very successful operation of a full LNG ship, and not just the main engines but the auxiliaries too. The ships haven't missed a stroke, they've been week in and out of Puerto Rico, on schedule and they are clean."

THE POWERPLANTS

Not only were the ships groundbreaking, the MAN ME-GI engines installed were the first in the world, so MAN Energy Solutions naturally had a vested interest to ensure success, as Wayne Jones, Chief Sales Officer and Member of the Executive Board, MAN Energy Solutions, explained. "In the lab and in the test bed, you're comfortable, but the proof in the pudding is when you install it on a ship. What I think is significant about this project is from the boardroom to the engine room, there was great support. And I don't think projects like this can work without that support."

MAN Energy Solutions ME-GI (-Gas Injection) engine two-stroke propulsion engines are designed to provide ship owners and operators with a solution with two-stroke technology without the greenhouse emissions such as methane slip. "The development of the ME-GI engine is one element of what we call the 'Maritime Energy Transition'," said Jones. "Essentially it is our call to action to reduce emissions and establish natural gases as the fuels of choice in global shipping." MAN Energy Solution has also developed an ME-LGI (-Liquid Gas Injection) dual-fuel engine that expands the company's dual-fuel portfolio, enabling the use of more sustainable fuels


Image: Greg Trauthwein

"As a business person I have a pretty good idea of my fuel costs for the next 10 years. When you look at where the price of compliant fuel is going … is it going to be a 40% differential to crude, 50%? Who knows. I do know that my cost of LNG will be relatively stable."

– Peter Keller, Executive Vice President, TOTE


Peter Keller, Wayne Jones & Greg Trauthwein

Considering LNG?

… Consider This …

Peter Keller, Executive Vice President, TOTE, arguably has more experience running ships with LNG fueled main engines than anyone in the world. For ship owners considering LNG fuel as an option, he offers this advice:

1. Relationship: "One of the things we're very positive about is the relationship with MAN at all levels, from senior leadership to the support. We had our fits and starts from the start, but we always had great support from PrimeServ."

2. Embed Early: "When we built these ships at NASSCO, we pre-assigned our chief engineers as the construction started. Our four chief engineers were all inspectors at the shipyard; they were there with the MAN representatives and the NASSCO people. From the very beginning we were all joined at the hip on this project to integrated this system on the ship. It kept us on good stead throughout the process."

3. Fill 'er Up (often): "We're refilling on every voyage, even though we could do two voyages on one tank. The last thing you ever want to do with an LNG is take it all the way down, because then it's going to heat up and you're going to have to cool it down again."

4. Communicate: "The number one issue for us was the relationship with the regulator and class, in this case ABS. Having them inside everything that you do every day is important. So many owners see their regulators and their class as almost enemies; you just can't do that."

5. Pipe it Right: "The cleanliness of LNG piping, the welding processes and the way that the gas is moved around inside the ship is really, really critical. We had a lot of issues is piping cleanliness, which is a shipyard issue.

6. Green is Clean: "When you go into the engine room of the Isla Bella, you can go down in your suit, it smells fine and there's no oily residue. It's clean as a whistle because the fuel is clean as a whistle."

such as methanol, ethanol and liquefied petroleum gas (LPG).

MAN Energy Solutions is the dominate player in powering the world fleet with reportedly more than 50% market share in the two stroke business. Still, Jones recounts long discussions in the boardroom in advance of its commitment to investing in the technologies to deliver innovative environmental solutions, as in additional to market and regulatory pressure, Jones and the company's leaderships have to answer to shareholders, too. "To start you have to have some radical thinking within your own organization because you have to invest at a different level: we are investing 7% of our turnover in R&D … that's a huge number," said Jones.

In the case of the TOTE ships, the investment didn't stop with R&D, as MAN placed its own people, from its service arm MAN PrimeServ, sailing onboard the ship for nearly 60% of the time to help ensure smooth operations and to serve as a resource if a problem arose. While Jones said today the selection of a dual fuel unit still requires an additional level of support versus a traditional diesel engine – perhaps 10% more – TOTE's nearly flawless running of the ships and the MAN ME-GI units is helping to bring this closer to the norm.

TOTE's Alaska division has also contracted MAN PrimeServ – MAN Energy Solutions' after-sales division – to convert its 'North Star' and 'Midnight Sun' RoRos to dual-fuel operation on LNG. The vessels are both currently powered by 4 × MAN 58/64 engines and will be retrofitted to MAN 58/64 retrofit units.

While the technical side is now proven, Keller figures that an attitude shift is the key to truly driving change. "From when I started, if there was black smoke coming out of the C4's at Port Elizabeth … 'who cared?' If it kept up for 5 or 10 minutes you'd get a call from across the street at headquarters, but it didn't have near the sensitivity it does today. The change is a good thing," Keller said. "As a company you have to do the right thing; today being environmentally appropriate is the right thing. Years ago if I had gone into a major big box retailer selling my wares as a company president and I went in with an environmental story, I would have been thrown out. Today, if I go to that same company and I do not have an environmental story, I'd be thrown out."

Image: © trahko/AdobeStock

CELEBRATING 1893 | 2018

125

HONORING THE PAST | INFLUENCING THE FUTURE

The Future *Is Now*

Decarbonization, Digitalization, Autonomy & the Future of Ship Design

In this EDITION

1893
First meeting of SNAME. President was Clement A. Griscom, President of the International Line and one of the most powerful men in American merchant shipping.

1900
Submarine Holland (later USS Holland) In the Raritan Dry Dock, Perth Amboy, New Jersey, in the spring of 1898. View looks toward the Kill. Photo Courtesy of Dr. R.K. Morris. U.S. Naval Historical Center Photograph.

1901
First report of Ship Model Basin at Washington Navy Yard issued by Naval Constructor David W. Taylor who designed the basin. First facility of this type in U.S. to test hull shapes.

1912
Launching of USS Jupiter, first electrically propelled Navy ship

Christopher J. Wiernicki,
Chairman, President & CEO, ABS
I have close ties personally and professionally to SNAME as I benefitted from a SNAME scholarship to fund my education as I obtained

a master's degree in ocean engineering from Massachusetts Institute of Technology (MIT). Also, as a SNAME Fellow and recipient of the Vice Admiral Emory S. Land Medal, the organization remains of key importance to my professional career and personal development. It's an organization that promotes excellence, recognizes innovation and rewards passion in the marine and offshore industries.

Harilaos Petrakakos,
P&P Marine Consultants Inc
Joining the Society of Naval Architects and Marine Engineers in New York and lately in Greece has

helped me expand my knowledge base with so many reliable technical and scientific publications. During the development time I found the Society's members supportive. Lately the involvement with SNAME activities fulfils the wish to pass the knowledge to the young and student members.

Richard A. Mueller,
President/CEO, NETSCo., Inc.
SNAME has been good for me, and great for my business. Membership in SNAME allowed me to meet many of the movers and shakers in the marine industry,

and allowed me to keep abreast of this rapidly changing industry and technology arena. I couldn't have gotten where I am today without my membership in SNAME.

Phil Moore, ***VP Engineering, Interlake Steamship Company***
"SNAME has been a great network to connect with industry professionals and assist with young engineers entering the marine field."

1915

President Woodrow Wilson signed into law the act to create the United States Coast Guard

From the desk of
Gene Sanders, Executive Director

A New Era @ SNAME

I am Gene Sanders, the new Executive Director of the Society of Naval Architects and Marine Engineers (SNAME). My "elevator speech" is a simple one. More than 70% of the earth's surface is covered in water, and 90% of goods delivered on this planet are delivered by ships. We build ships, the largest objects manufactured in the world. So from where I'm sitting, I can only ask: "who wouldn't want to be a part of "Planet SNAME?!"

Since 1893, this world maritime community of ours has represented industry professionals who have designed and engineered ships of nearly every imaginable type, shape and size, from commercial use to naval use and nearly every other use in between. This year our society proudly celebrates its 125th anniversary, years that are rich in history as SNAME and its members have played an important role in so many historic advances in maritime.
Even with 125 years of experience, SNAME, like the industry it serves, continues to evolve, and both our organization and our operations still have plenty of room for improvement and growth. Let's start with SMC, our annual conference and trade show. My goal is to make SNAME "the" resource for finding the world of products and services that are used globally in ship design and construction. SNAME's Annual Meeting should not just be the world's best engineering conference, it should be "the" world's premier maritime product showcase.

In addition, SNAME is a treasure trove of information, housing well over 10,000 reports, technical papers, journal articles and books that are currently a little difficult (and at times, virtually impossible) to find. We will soon migrate this content to "One Petro," a platform developed and hosted by the Society of Petroleum Engineers, so that you will finally be able to easily access the best naval architecture and marine engineering content in the world. Be on the lookout!

One of the greatest assets of a SNAME membership is our 19 global sections. When you join SNAME, you're not joining an anonymous group of thousands who meet once each year. You are placed into a community of professionals in the region right where you live, enabling you to attend meetings in your area to regularly exchange ideas and information. Each SNAME section is both a local professional network, and a bridge to SNAME experts in other sections across the globe. Your SNAME community can bring the entire world within reach! Another way we're helping to grow SNAME is by offering corporate participation through our affiliate program.

As an individual member society, corporate engagement was previously frowned upon. But I believe that in order to improve the overall maritime community, SNAME must forge stronger relationships with the C-Suites in our industry.

Our new corporate affiliate program is attracting those industry leaders, and we will continue to work hard to grow and expend this element of our society. Whether it's through our annual meeting, section events, various symposia or even webinars, this direct access to industry thought leaders will help SNAME identify and report on the trends and technological advancements that our members need to know about!

SNAME has built an impressive 125 year heritage, and I know we will achieve even greater successes throughout our next 125. We have an enormous opportunity to expand our reach, to build better, stronger, faster, safer vessels, to share our insights and wisdom, and advance the industry as a whole. I am truly humbled that I have been asked to lead us forward to reach these new heights.

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VESSEL EFFICIENCY

VISUALIZE YOUR
LUBRICATION CHART

DISCOVER THE RIGHT
PRODUCT FOR YOUR NEEDS

Harness the power of knowledge

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Committed to Better Energy

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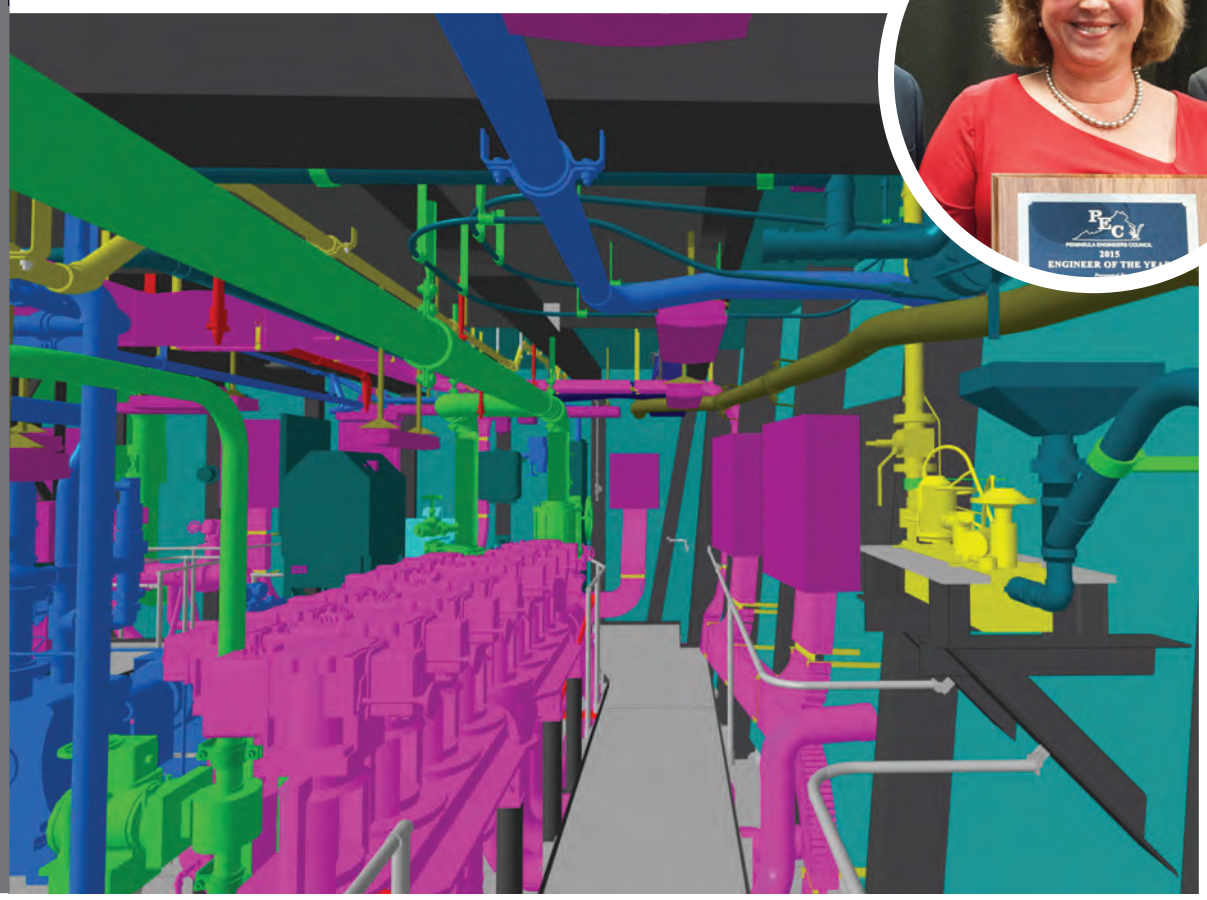
Lube-On-Ship

Total Lubmarine newest service allows customers to choose the right product for their ship's lubrication needs. Lube-On-Ship highlights our continued dedication to innovative solutions. Visit our app at **www.totallubmarine.com/lube-on-ship**



Images courtesy: Huntington Ingalls Industries, Newport News Shipbuilding & Suzanne Beckstoffer

"SNAME has been my professional organization throughout my entire career. SNAME has provided many education and leadership opportunities and is the backbone of my maritime business network."

Beckstoffer

One-on-one with Suzanne Beckstoffer, an accomplished engineering leader and business woman, the first woman president in SNAME's 125 year history

As the Society of Naval Architects and Marine Engineers (SNAME) celebrates its 125th anniversary in 2018, it will celebrate another historical milestone at the start of 2019 when Suzanne M. Beckstoffer takes the helm of SNAME as president, the first woman to hold this position in the association's history. We met recently with Beckstoffer to discuss her distinguished shipbuilding career, as well as her insights on the value of SNAME as a powerful networking and career-building tool.

By Eric Haun

When did you first know that you were destined for a career in maritime?

I became an engineer because of my 10th grade math teacher, Mrs. Baldwin. We students all thought she was the meanest old woman who ever lived, but in fact she was an excellent teacher. She even drove another girl and I to NC State University for a weekend seminar on engineering careers for women. I took one look at the water lab in the civil engineering building and I was hooked!

Later, when I graduated from college with my civil engineering degree, I really wanted to live near the coast and build bridges. Unfortunately, no bridge-building job offers came through, but shipbuilding was certainly near the water and looked interesting, so I decided to try it. I am fortunate to have had so many exciting opportunities at Newport News Shipbuilding to use both my engineering and business skills. Shipbuilding was a great career choice!

This is a good testament to the power of educators!

It is. In fact, a few years ago I had reached some significant career milestones and realized I'd never properly said "thank-you" to Mrs. Baldwin. I investigated and found she was living in a retirement community in my hometown, so I sent her a letter telling her about some of the interesting things I'd done, and expressing my appreciation for her setting me onto this terrific engineering career path. She kindly wrote back, actually remembered me, and seemed pleased to know her teaching had made an impact. Well, about two months later I learned that Mrs. Baldwin had died, and that my letter was read at her funeral. I'm so pleased I got to tell her how much her influence had meant and I would encourage others to say thank you to their teachers!

Let's discuss your shipbuilding career, specifically the challenges of being a woman, rising through the ranks in a field dominated by men.

My mother never expected her daughter to work in a shipyard! My parents are both educators, and encouraged my academic interests, but I think they believed my love of math would lead to a career in finance. Maybe now that I'm Chairman of the Board of BayPort Credit Union, they think I'm finally doing what they'd expected all along.

Newport News Shipbuilding is a great place to work for anybody with the skills and interest in shipbuilding. Our current president Jennifer Boykin attended the Merchant Marine Academy, and several other vice-presidents are women. Clearly the workforce has become more diverse since I started my career. Everyone has challenges, any job has ups and downs, and anything worth doing takes hard work, and I am proud and grateful for my career at the shipyard. Every time I see one of the ships I worked on in the news on some important mission, I feel a sense of pride in being part of something much bigger than myself.

I remember my first job interview in the Hull Technical Department in 1982. Mr. Coward, the department head, was talking on the phone when I arrived. I waited at the door until he finished his conversation, when he spun around in chair, saw me, and blurted out, "You don't look like an engineer, you look more like a girl to me!"

We both had a good laugh, made our introductions, and carried on with the interview and plant visit. He turned out to be a good mentor and friend, and in fact I still make his She-Crab Soup recipe for Thanksgiving and special events. Several of my bosses and colleagues over the years also proved to be good mentors. Most were much older than I was and had children about my age. I think some of them realized their own daughters would also join the workforce and they were modeling the way they hoped their family members would be treated.

What do you consider your greatest professional accomplishment at NNS?

Looking back over my 34-year career at NNS, I see a new technology theme in

nearly every position I held. When I first arrived at the company, ship designs were still done by pen and ink. I was one of the first 10 people who learned how to use CADAM, the company's first computer-aided design software package. I also spent nearly a decade working on the company's in-house 3D solid modeling software VIVID which we used to design the SEAWOLF submarine.

Later, I managed the waterfront installation and production testing of our $40 million robotic cutting and welding lines called the Automated Steel Factory. During early development of the FORD Class aircraft carrier program, I worked with our Innovation Center and the Navy to identify cost-saving technologies for the new ship design. Then I had the chance to lead our Research & Development organization for several years, an exciting opportunity to explore more innovations for our key product lines and manufacturing processes. One project I'm particularly proud of is our pioneering use of immersive 3D visualization to "walk through" and review ship spaces before construction; our design, planning, and construction folks all made use of it, as well as the Navy customer.

The last project I led before retiring was the company's migration from one computer toolset to another for design, planning, construction and lifecycle support. Just to make it a little tougher, we were also in the middle of Ford design and construction at the time. We had to migrate the entire ship design with near-perfect accuracy and re-train the workforce to use new software while maintaining production schedules. Looking back, it is gratifying to see so many of the technologies I helped introduce still in use or foundations of continued advancement.

"I see a lot of fresh energy at SNAME. We've grown our student sections and branched out internationally. The maritime and offshore industries are truly international and projects in our field span the globe, so it's appropriate that our professional society be global, too."

How has the industry evolved most dramatically?

Shipbuilding goes back to the Phoenicians and used to be considered a dirty and dangerous job. Shipbuilding today is remarkably sophisticated. There is still a high level of expert craftsmanship, and now it benefits from virtual tools, augmented reality, robotics, and advanced manufacturing technology.

What one technology do you believe made the process of shipbuilding more efficient?

From my experience, the 3D product model has been transformational in ship design and construction. It's hard to believe now, but I remember when designers from each discipline – piping, mechanical, ventilation, etc. – were basically working blindly in a space, not knowing where the other designers were running their systems.

A skilled and experienced designer had to take all those systems, envision them in space, and try to build a composite drawing of everything in the compartment. It looked like spaghetti and of course there were always fouls from systems running into each other. Then the trades would build enormous full-scale wood and plastic mockups of the most significant ship spaces (think: whole submarine inside a building!) to ensure they could build what was shown on the drawings.

Finally, when actual construction got underway, the shipfitters would have to locate and fix any remaining fouls and figure out the to-fit work. It took a lot of skill and know-how to put everything together. Now all the design and construction planning work is done in a single product model. Each discipline can see the others and downstream customers can walk through the design as it develops. What a difference!

How long have you been a member of SNAME? How did SNAME impact your career?

I've been a SNAME member for 35 years. My first supervisor at the shipyard recommended I get involved with SNAME as a way of building my professional network. Then he made sure I was appointed House Committee Chair for the Hampton Roads Section, so I had to check in all meeting attendees and got to know people quickly. He also occasionally asked me to review and comment on technical papers.

My favorite memories of those early SNAME years were the opportunities to rub elbows with senior company executives. Mr. Ed Campbell and Mr. Pat Phillips were presidents of Newport News Shipbuilding; both also served terms as SNAME presidents, and they regularly attended the local section meetings, too. It was great for a young engineer to meet company leaders and they also got to see me take leadership roles at the local level at a very young age. It was a good way to stand out from the crowd and become recognized by management as a can-do person.

You are set to take over as SNAME president in 2019, the first woman president of the organization. Why did you want the job?

SNAME has been my professional organization throughout my entire career. SNAME has provided many education and leadership opportunities and is the

1916
First ship-to-shore radio telephone voice conversation from USS New Hampshire off Virginia Capes to SECNAV Josephus Daniels in Washington, DC

1917
Launching of battleship New Mexico (BB-40), first capital ship with turbo-electric propulsion

1933
Commissioning of USS Ranger, first true aircraft carrier

1939
Naval Research Lab recommends financing research program to obtain power from uranium.

backbone of my maritime business network. I've also served as a volunteer at local, regional, and national levels for more than three decades. Now it's an honor to represent my industry and I'm looking forward to serving as President as SNAME celebrates 125 years.

Looking at the organization today compared to when you joined, how is it the same and how is it different?

I see a lot of fresh energy at SNAME. We've grown our student sections and branched out internationally. The maritime and offshore industries are truly international and projects in our field span the globe, so it's appropriate that our professional society be global, too. What hasn't changed is SNAME's strong base of volunteer member-leaders.

Meet SNAME's New President

Suzanne M. Beckstoffer is a Fellow and President-Elect 2019-2020 of SNAME. She is Chairman of the Board of BayPort Credit Union, a $1.6 billion financial institution with 140,000 members, headquartered in Newport News, Va.

She retired in 2016 as an Engineering Director at Newport News Shipbuilding, after a 30+ year shipbuilding career. During her tenure at NNS, she led the migration of the new Ford class aircraft carrier 3D product model to a new Product Lifecycle Management toolset; directed the company's R&D program; managed the installation of the Automated Steel Facility robotic cutting and welding lines for steel fabrication; and performed engineering and design activities for aircraft carriers, submarines, and commercial vessels. The Peninsula Engineers Council elected her Engineer of the Year 2015.

She continues her work in engineering education and financial literacy, serving on boards at North Carolina State University, Christopher Newport University, and the ABET Industry Advisory Council. She holds a B.S. in Civil Engineering from NC State University and an MBA from The College of William and Mary. She is a Past President and Paul Harris Fellow of the Warwick Rotary Club.

Every leader has goals. As incoming president of SNAME, what are your top goals?

One of my favorite jobs is strategic planning. The SNAME Planning Committee and I have been working diligently on strategies that will position the Society for a strong future and sustainable growth.

Increasing SNAME membership value and establishing strong relationships across the maritime communities are two major focus areas. Our SNAME events, research programs, industry partnerships, educational activities, and member sections are already good; I want us to go from good to superb!
We also need to actively engage our student members as they graduate and build their careers. It's part of our professional duty to provide these young professionals with leadership and education opportunities, and mentor them to be the SNAME leaders of tomorrow.
Another area that engineers often struggle with is marketing and communications. Sometimes the old introverted nerdy engineer jokes hit a bit too close to home. So, we are working with SNAME's excellent professional staff to help us spread the word about the great work we do. We have exciting STEM programs for young people, stories to tell about the fascinating work SNAME members perform, interesting research work underway, and many amazing job opportunities in the maritime industry. We need to let our SNAME lights shine!

What do you see as the defining technical trends driving maritime toward the future?

Autonomous vessels are an interesting development in the maritime business, and I think we're just beginning to see the impact and future implications. Like self-driving cars on land, autonomous vessels have enormous potential. From my own background in nuclear-powered ship design and construction, we are seeing increased automation in ship operations that helps reduce costs, but large naval vessels are not yet ready for unmanned operations. However, commercial and smaller naval ships are getting closer to unmanned operations in certain circumstances. And of course, unmanned aerial and undersea vehicles are already in active use in many naval and commercial applications.

As SNAME president, do you plan to make training and education a focus?

When I decided to retire from Newport News Shipbuilding, I started planning over a year in advance for what I wanted to do in the next phase of my life. In fact, I converted a little blue SNAME notebook into my personal strategy and detailed action plan. On the first page, as I defined my new professional persona, engineering education rose to the top of the list.

SNAME already has a strong educational focus at the university level. SNAME is a member of ABET, the organization that accredits university engineering, science, and technology programs. I want SNAME's education program to span all the way from elementary through college and professional education. We already have several strong programs, and many more opportunities to grow. One of my personal favorites is The Apprentice School SNAME Boat Design Competition, led by the Newport News Shipbuilding Apprentices' SNAME student section.

For more than a decade they've involved over 200 high school students annually in a clever boat design competition that introduces the students to fundamentals of ship design and construction. The best part is the four top designs are actually constructed from sheet metal by the apprentices and the students get to race them on Lake Maury behind the Mariners' Museum in Newport News. It's fabulous, and the design competition has created a wonderful pipeline of students into shipbuilding careers.

1946

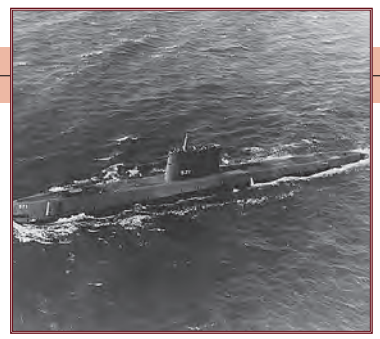
ENIAC, the first successful digital computer, becomes operational. ENIAC in Philadelphia, Pa. Glen Beck (background) and Betty Snyder (foreground) program the ENIAC in BRL build-ing 328. U.S. Army Photo

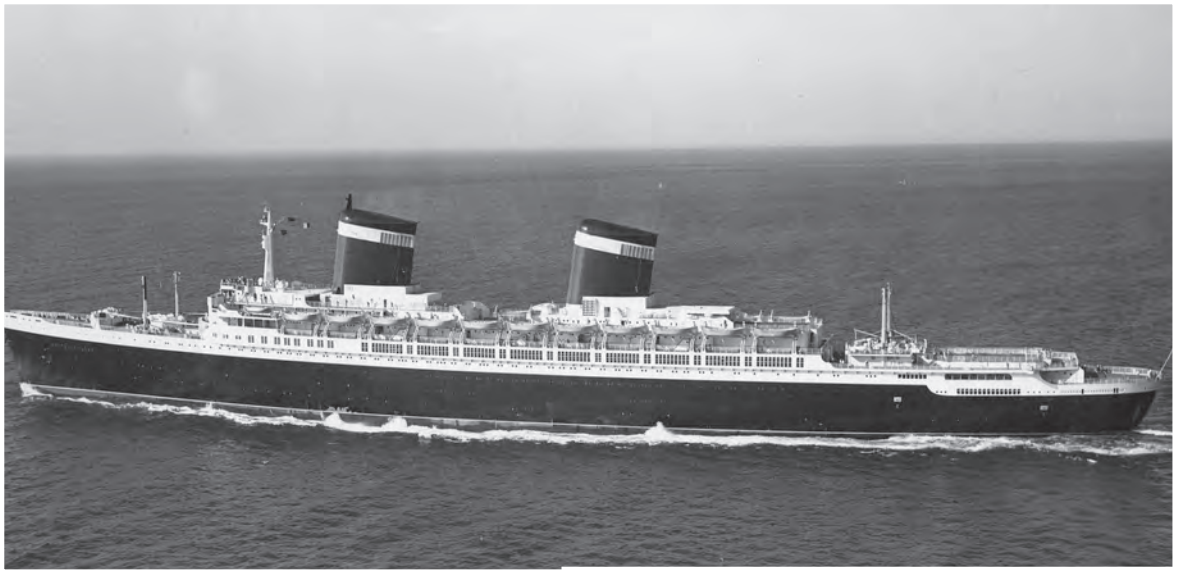
1952

SS United States – "BigU" – goes on sea trials June 1952.

1955

USS Nautilus (SSN-571), the first nuclear-powered submarine, casts off lines at 1100 and sends message "underway on nuclear power". U.S. Navy Historical photo.





A World of Maritime Records

(Images: top left, proceeding clockwise)

1898: John P. Holland in the submarine Holland. Courtesy of the U.S. Naval Institute, Annapolis, Maryland, 1966.

1952: SS United States – "BigU" – on sea trials June 1952. (Source: Arthur Taddei, member #1741510 since 1959)

March 2018: The world's largest cruise ship, 228,081 GRT, 6,680 pax., Symphony of the Seas. (Photo: Royal Caribbean)

June 2017 - World's first icebreaking LNG carrier Christophe de Margerie christened. (Photo: SCF Group)

July 2017 - The 488-meter Prelude FLNG, the world's first floating liquefied natural gas (FLNG) project. (Photo: Shell)

1956

Departure of world's first of containership by Sea-Land Service, with converted T2 Ideal-X. Another "one small step for mankind."

1957

Launching of Russian nuclear-powered icebreaker Lenin, the first civilian nuclear-powered vessel.

1958

USS Nautilus (SSN-571) is first ship to reach the geographic North Pole submerged.

1959

Launching of nuclear-powered vessel Savannah at New York Shipbuilding Co.

125 Years & Counting

As SNAME celebrates its 125-year milestone, we look back at some historic high-points, we look ahead to the challenges coming.

When the Society of Naval Architects and Marine Engineers was founded in 1893, the maritime world was well past the dawn of the age of technology. The steam engine had been with us for nine decades, and the art of building a hull from iron and moving it with a screw propeller had first been accomplished nearly a half century before.

For a number of years after the Civil War, marine technology in the United States was dormant. The war had virtually ended naval ship construction until the mid '80s; our merchant fleet was very slow in its conversion from wood to iron and steel, and from sail to steam. The immense inflationary result of the war seemed to put an end to any competitive edge we might have had previously. In addition, the nation's eyes were firmly focused on the western frontier and the oceans were forgotten. Even the continuing waves of immigrants, which had been previously been passengers aboard our sailing packets, were now to be found in the steerage class of European steamships.

This was the picture when, on April 28, 1893, 13 maritime professionals signed the articles of incorporation of SNAME, an act which not only breathed new life into the seemingly moribund field of marine technology, but also brought those two specialties – naval architecture and marine engineering – together to work for the common good in the creation of powered iron or steel vessels.

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For this remarkable first step, we must thank such industry stalwarts as William H. Webb, Charles H. Cramp, Washington Lee Capps, W.T. Sampson and the other nine influential men of merchant or naval background who could envisage the rise of American expertise and enterprise at a time when the seaways were almost universally crowded with the fruits of European technology. There followed a century-long learning experience, throughout which we as a professional group were eager to learn and to better the performance of ships of all types. Under the able and long-time leadership of Admiral David W. Taylor (who presented no less than 20 interesting and worthwhile papers before our annual meetings during the 40-year period from 1893 to 1933), we learned much of the basic theory of the speed and power of ships. Later, the mysteries of vibration of hull and propeller were made clear to us by Professor Frank M. Lewis, and other leaders of tour industry guided us through those 100 years.

Little by little, year by year, and scholarly paper by paper, the naval architects, marine engineers, shipbuilders and others who contributed to the success and safety of merchant and naval vessels

1960

Bathyscaph Trieste descends to deepest part of the ocean, Marianas Trench

1961

USS Enterprise (CVN-65), formerly CVA(N)-65, was commissioned November 25, 1961 as the world's first nuclear-powered aircraft carrier. Vessel built at Newport News.

1967

Torrey Canyon oil spill off U.K. leading to new rules for improved tanker safety and spill response

1969

The first Offshore Technology Conference, devoted to the development of offshore resources for the petroleum industry in the fields of drilling, exploration, pro-duction, and environmental protection.

were able to broaden the complex field of knowledge of many aspects of our craft. The subject matter discussed at our meetings varied with time, as new problems were uncovered or competitive issues became popular. Drawing upon a century of retrospect, the one error we may have made — in 1903 — was in recommending to not adopt the metric system, described in a paper presented by Captain Joseph H. Linnard. During the earliest days, the attention of many was focused upon the "Atlantic Greyhound," the high-speed passenger carrier, mainly from the British, French and German builders that dominated transatlantic commerce.

The first paper presented at the 1893 meeting was Charles H. Cramp's "Evolution of the Atlantic Greyhound." At that time (and for many years before and after), our shipbuilding and operational costs were sufficiently high as to preclude our entry into that race, and we were well aware that the European greyhounds were the recipients of that ugly device – subsidy.

It was not until 1936 that our annual meeting assumed an international flavor, with papers prepared by leading technical representatives of the principal maritime nations – Great Britain, Germany, France, Italy, Japan and Sweden. The lone American presenter at the "International Meeting of Naval Architects and Marine Engineers" in that year was Ernest H. Rigg, a Society stalwart in shipbuilding. Two prescient papers in the domestic portion of the 1936 meeting were "Modern River Towboats" by James S. Brodie and "Oil Tankers" by John W. Hudson. Both papers focused upon aspects of the respective subjects that would radically alter the character of those two vessel types. Alas, the events of the following decade would make it impossible to repeat the success of the 1936 international meeting.

There is little doubt that the shipbuilding program that produced the vast armada of commercial and naval vessels during World War II was of incalculable importance in the winning of that conflict, and it also contributed significantly during the postwar years to the radical changes that altered shipbuilding practices throughout the world. That American shipbuilders were unable to benefit during the 1950s and beyond is part of the unfortunate legacy of the Civil War period.

But make no mistake, as the industry faces the gauntlet of technical challenge to meet the IMO's mandate to reduce GHG emissions by 2050, global climate change and all that it entails will be a driving force in marine design, construction and operation for the coming generation.

Despite this, those many years that passed as we moved to our Centennial in 1993 and beyond were marked by enormous increases in our knowledge of many of the early unfathomable mysteries of our professional life. A classic example of how our approach to hull design and powering had changed was the development and application of computer-aided design (CAD) and computational fluid dynamics (CFD) to marine vehicles, borrowing the latter technology from the designers of airborne vehicles. No longer would ship design be completely beholden to model testing and the naval architect's practiced eye. The utilization of these latter-day practices helped to make possible the building of successful high-speed vessels of types that were never imagined in earlier times.

The latter part of the twentieth century also saw radical changes to the methods of cargo handling. Containerization was a remarkably successful development while others, such as Lash and Seabee barge carriers, were of limited utility despite the original concepts which were to extend the reaches of a port such as New Orleans into the vast Western river system. However, the eventual decline of break-bulk liner cargoes has left sea transportation significantly more efficient than could be imagined 60 years ago.

Among the other also-rans was nuclear propulsion, which was employed on only two merchant vessels worldwide. The propulsion plants of those vessels dated from the system's early developmental days and were abandoned because of safety considerations and virtually insurmountable economics. During the 1950s, a well-known ship owner proposed a fleet of container ships for intercoastal operation using nuclear propulsion, but the proposal was dropped for a number of reasons. The past quarter century has also seen a significant broadening of our knowledge of the construction of steel structures – the grillages of plates and shapes which make up the typical ship's hull. We are determined to build these

1969
Russian icebreaker Arktika makes the first surface voyage to the North Pole.

1979
Launching of first Trident submarine, USS Ohio (SSBN-726) at Groton, CT

1979
The first Blakely Smith Medal was presented to Blakely Smith at the annual meeting of SNAME in 1979, when Blakely was 86 years old.

1984
Sea Shadow (IX-529), an experimental stealth ship built by Lockheed for the U.S.

structures to be long-lived and capable of supporting the loads placed upon them. In short, we are looking for that holy grail of shipbuilding – a vessel that can be relied upon unquestionably to carry their design loads under the severe conditions encountered at sea. Suffice it to say that we have made significant strides toward that goal, but more work remains to be done.

Today, the '4th industrial revolution' – or digitalization – is impacting all industry and business. This is also true in the maritime sector, as ships not only become a more intimately connected node in the global logistics chain, but they also are under ever-stricter environmental mandate to reduce greenhouse gas emissions.

Increased use of data continues to change how ships are designed and operated, with new highly-connected ships equipped with advanced sensor technology, powerful satellite connections and intelligent software that are conspiring to reduce costs, increase efficiency, as well as opening the door for new possibilities for increased autonomous and unmanned operations.

But make no mistake, as the industry faces the gauntlet of technical challenge to meet the IMO's mandate to reduce GHG emissions by 2050, global climate change and all that it entails will be a driving force in marine design, construction and operation for the coming generation.

With environmental issues and digitalization, the pace of change is quickening, and shipping could experience as much change in the coming two decades as it has since SNAME was created 125 years ago.

Achieving strict new environmental mandates will not be easy nor quick, and it is clear that there is no single silver bullet. A wide array of options – some proven and other still in earlier stages of development – including LNG fuel, slow steaming, scrubbers, batteries, fuel cells, rotor sails, hydrogen and ammonia – are among the many approaches to cleaner marine propulsion, none in and of themselves providing the full solution.

What is clear is the need for the Society of Naval Architects and Marine Engineers and similar organizations to stand as a remit for intelligence and action, the cornerstone of the maritime industry's future, which starts with education.

Credits:
"115 Years of Maritime History" by William duBarry Thomas;
Eric Haun, web editor, MarineLink.com

The Future is Now

With new leadership in place, Gene Sanders, SNAME's new Executive Director, lays out his vision for a vibrant, growing society for the next generations

125 Years, it's a great start! I'm Gene Sanders, and I have been given the enviable opportunity to take SNAME into its next phase in one the most important industries in the world! In my first few months as SNAME's new Executive Director, I've been working with the Board and various committees on new ventures and directives, which will be exciting and beneficial for our members and the industry as a whole. Before I reveal my vision for the future, it's important to share our most recent challenges and accomplishments right here in Alexandria, Va. Our staff is well equipped to provide a new and fresh perspective as we build the path toward our future, and it's worth noting that most of our employees have not yet reached their one year anniversary with SNAME (myself included). I think that's a great thing! We have plenty of resources for historical perspective, and our staff is committed to identifying and solving problems vs. doing things because "that's the way it's always been done." So with this in mind, I'm going to open the proverbial kimono and let you know what we've been up to over the last six months.

First things first ... the secret's out. Our website stinks! SNAME.org has been severely limited by inadequate and outdated technology, and our current site has neither the look nor feel of the highly technical organization it represents. Whether it's applying for or renewing your membership, searching the 12,000 + documents in our repository for that one important paper you need, or even just logging in to view your own profile, SNAME.org has excelled at complicating even the simplest of tasks! It therefore brings me great pleasure to tell you that our website is being completely overhauled. By the time this article is in print, you'll already see a more modern adaptation of our old site. While the functionally for this first phase is largely cosmetic, it's a taste of what's to come as we transition to an entirely new website in 2019.

Next, a note about our difficult to find content… You may have noticed that what once was difficult has now become impossible! To provide our members with the information and research they need, when they need it, we're migrating our digital content to a site called OnePetro.org.

One Petro offers better, faster, and more accurate access to SNAME documents, but it also hosts content from 20 additional associations in related industries. This means your searches can yield even more results from a broader range of sources, and SNAME papers will appear in searches by thousands of others outside the SNAME circle. It also means that we've had to "close the SNAME library" while we transition to One Petro, but when you see the end result, I know you'll agree it was worth the wait.

The third project is all about our database. I was shocked to learn that there are almost 1,000 different fields in our database, each one capturing a single facet of our members' personal and professional history and committee engagement, as well as detailed event and product information and the associated accounting documentation that goes along with all of it! We are now in the process of minimizing what we need to capture, to ensure your online experience (and HQ's) will be much, much smoother. And now to answer the big question… What are we doing for the next 125 years?

CORPORATE AFFILIATION

We have initiated the first SNAME program that allows an organization to take advantage of the benefits of individual membership through shared knowledge and expertise at our networking events, webinars, and presentations – while also increasing their organizaton's visibility via more traditional branding opportunities in SNAME media outlets. This is a great way to build and strengthen our industry relationships, which will in turn provide even greater value for our members.

EDUCATION

As we move forward, SNAME is already working on continuing education and certification programs for our members, and we plan to launch new and exciting learning and accreditation opportunities for our members. These new education programs will be a hybrid of both in person certification programs and e-learning technologies.

STEPPING OUT

In the past, SNAME has been regarded as a rather staid, stoic group. We did not self-promote, we didn't boast our many assets, we only offered an opinion only when asked (and even then, after very careful consideration). Our meetings and events were – and still are – highly technical conferences focusing on peer reviewed content and educational sessions, with the opportunity to network with others in our field. We will continue to follow this tradition, but we will expand our reach, drawing interest from and collaborating with others across similar fields and industries.

- ***SNAME New Technology Solution Center at OTC***: For the first time, the Offshore Technology Conference is allowing one of its association affiliates to represent its strength on the show floor. SNAME will be hosting a technology solution center, featuring products and services necessary in the offshore community. This is a dynamic new venture for SNAME, one which just might serve as a model of SNAME's participation in future events.

- ***Strategic Outreach & Partner Events***: At the 2018 International

WorkBoat Show in New Orleans SNAME will host a reception for the show's OEM exhibitors. I invite you all to come to the show and listen in as our experts discuss ***"What Keeps You Up At Night?"*** – the top ten things a workboat manufacturer needs to know.

• ***Workforce Development:*** SNAME is in discussions with several groups regarding collaboration models designed to ensure ocean engineering professionals stay at the forefront of today and tomorrow's workforce needs. This includes board-level participation in DC StemNetwork, supporting a member-designed program that teaches math skills through boat building, and upgrading our career center, working with both our existing provider and one of the top recruiting firms in the world.

EDUCATIONAL MATERIALS

SNAME has recently released three updated T&R bulletins, and we're working on a 30+ chapter revision of our Marine Engineering text book, as well as an update of our renowned PNA series. We will be offering individual chapters for sale as they become available, and we've already got one complete chapter available for purchase, and four more are awaiting their final touches before release! In this regard, we are able to deliver content when it's ready, regardless of the status of additional chapters in the book.

SMC CONFERENCE

The Annual SNAME Maritime Conference is a solid (but underachieving) event, bringing more than 1,000 engineers together each year to discuss the latest in ship design and engineering. We need to take this to the next level, and have the products and services discussed in the classrooms available on the show floor for all participants to see, touch and feel. Much like a high school science fair, a tradeshow floor is the place to go to see relevant products in action and on display! In the past, SNAME had limited its exhibitor audience (and severely reducing any potential "Wow" factor) by confining the exhibition space to a tiny 8'x10' booth. You cannot fit any equipment in a space this size, and there is little attraction for a participant to visit the show floor. After all, when you're rubbing elbows and exchanging knowledge with fellow naval architects and marine engineers, why would you want to stop and collect brochures?

The ships that SNAME members design and engineer are among the largest products manufactured on the planet. I believe our conference should reflect this. SMC should be the largest product showcase for all things related to shipbuilding. That's tens of thousands of products! Where are they? Why aren't they at our expo? Well they WILL be! I have a vast amount of experience in growing some of the largest trade shows in the world. I have done it before, and I will do it again at SNAME. This won't happen overnight, but we'll be stronger in Tacoma, and we will be on our way to realizing this vision by the time we roll into Houston in 2020!

I don't know about you, but I'm excited! I invite you all to come aboard and join me on this journey as we head into the next 125 years. I may be the new guy, but I have absolute confidence in the ship I've been tasked to steer. After all, it's been carefully and skillfully crafted by the hands and hard work of every SNAME member since our keel was laid in 1893.

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Net Zero Carbon

IMO's 2050 deadline to reduce GHG emissions 50% from 2008 levels has set off a gold rush to develop Zero Emissions Solutions

By Patricia Keefe

Climate change is the biggest issue facing [all aspects of] the maritime industry, said Kitak Lim, IMO secretary general, in an interview earlier this year with *Maritime Reporter & Engineering News.* He predicted that shipping could experience as much change in the next 10 to 20 years as it has in the last 100 years, as the industry races to meet a number of challenges, among them sustainability.

According to the International Chamber of Shipping (ICS) the industry is responding, reducing its total CO2 emissions by more than 10% between 2007 and 2012, and boasting a 20% reduction in CO2 per tonne/km compared to 2005 levels. It also quotes numbers from the International Council on Clean Transportation, which says international shipping's emissions had already dropped 8% between 2008 – the industry peak – and 2015. The International Transport Forum (ITF), meanwhile, claims it is possible to virtually decarbonize shipping by 2035, well ahead of IMO schedule, if the right policies, technologies and incentives are put into place "now." In addition to the ICS and the OTF, there is a substantial pool of industry groups – including shippers, ship owners and shipbuilders, ports, etc. – that already have organizations in place hard at work addressing pathways to emissions reduction, including the development of radical new ship designs. The industry has not been sitting idly by wallowing in its fumes.

NAILING IT DOWN

Still, leaving nothing to chance or shipping's best intentions, in April, IMO Marine Environment Protection Committee (MEPC) members agreed to lay down a formal, multi-phased requirement to move to a 50% cut in GHG emissions by 2050, a mandate that builds on three earlier regulations – one calling for the implementation of a global carbon emissions data collecting and reporting system by 2019, one setting a cap on sulphur content in marine fuels at 0.5%

by 2020, and another, using the Energy Efficiency Design Index, to regulate a three-phased increase in new ship efficiency, of 10% by 2020, 20% by 2025, and 30% by 2030. The IMO also called for a least a 40% reduction in carbon emissions by 2030, and 70% by 2050.

Post 2050, the plan is to reach zero GHG emissions as soon as possible during the second half of this century. By 2023, the group hopes to adopt a more detailed, revised strategy, and have ironed out sticky issues such as helping less developed countries bear the financial load of cutting emissions. Given those drivers, DNV GL's second "Energy Transition Outlook" report (2018) predicts that carbon-neutral fuels will surpass the use of diesel fuels by 2050, primarily due to alternative fuels, logistics improvements, speed reductions, and the "full impact of gradually improving the energy efficiency of new ships."

Decarbonization is officially HUGE. The IMO's slate of shipping efficiency and emissions reduction deadlines have laid down the gauntlet, lit the torch, and made climate change real for the industry. But anyone looking for the holy grail of that one solution that walks on water as the one-size-fits-all, emissions-mitigating answer can stop now. There isn't going to be one solution, but many. And one of the inherent drawbacks of much of that many is that they are today, and will likely be, less energy dense than diesel, which means whatever new fuels and energy-storing solutions win the day, vessels are going to need to consume and store a lot more fuel than they do currently. The ripple effect of that will be, well, huge.

COMMENCING COUNTDOWN

The IMO's tiered countdown to "zero" guarantees that virtually every corner of the marine and energy sectors will be singularly focused on fueling efficiency and eradicating emissions and other forms of entry for pollution for at least the next 30 years. Energy generators, sources and storage; ship design; engine, boiler and other propulsion equipment; lubricants; coatings; sealants – every part and parcel of every vessel type is going to be turned inside out, upside down, redesigned, reformulated, re-piped and re-routed – even relocated – as naval architects and engineers, ship owners and operators, investors and marine financiers, researchers and marine environmental organizations of every permutation put their heads together to puzzle out the best routes to net zero Zen. Operational strategies are also going under the microscope.

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And not a moment too soon for climate warriors disappointed that the IMO did not go further and mandate emission cuts of 70% by 2050 to meet the 2015 Paris Agreement to keep global temperature increases under 2 C, and as close as possible to 1.5 degrees. They are deeply worried about the extent to which a hotter planet is melting ice caps, heating up and acidifying the seas and outrunning the ocean's natural ability to cope with carbon sinks. And with good reason.

Sure, IMO member counties could have acted sooner, but "the targets are a huge step for the industry and should be celebrated as a big step in the right direction," says Ned Harvey, a managing director for the Rocky Mountain Institute/Carbon War Room, a non-profit that works with vendors and industry to tackle environmental issues

LEFT IN SHIPPING'S WAKE

Still the cheapest and most environmentally friendly of all transport modes, shipping nonetheless produces an estimated 2.4% of emissions. It doesn't sound like much, but that's roughly equal to the output of Germany, the sixth largest emitter of carbon. Shipping as a whole is a lot cleaner than other transport sources of carbon emissions, i.e. planes, trains and automobiles. Indeed, driven by the trend toward megaships carrying as many as 20,000 containers, shipping has never been more cost-efficient and more environmentally friendly. Bigger, newer, more modern vessels, in some cases running on new forms of fuel and propulsion, means fewer older, smaller ships carrying the same number of TEUs among them, operating primarily on bunker, together producing considerably more emissions.

But ships are basically mobile power plants. "It's not that ships are particularly dirty, it's just that there are an awful lot of them," says Christopher Barry, an engineering consultant and chair of both SNAME's Small Craft Technical and Research Committee, and its Ocean Renewable Energy Technical and Research Panel, and collectively, they produce a lot of emission. And there are going to be even more plying global trade routes despite the advent of those super-sized container ships. The last 25 years have seen a four-times increase in the number of vessels transiting 24/7, oceans the world over, carrying 90% or more of the world's commerce – while mostly burning bunker fuel. In the United States at least, the transportation sector surpassed energy in the last couple of years to become the number-one emitter of greenhouse gases. Shipping demand keeps climbing and the IMO believes the sector's emissions could balloon to as high as 17% of global carbon emissions by 2050, if a sea change in fueling does not take place.

It's very important that the industry makes those changes, agrees Rick Ashcroft, functional vice president technology and Chair of the Technology & Research Steering Committee at the Society of Naval Architects and Marine Engineers (SNAME). "There are things you have to do because at some level you worry about the environment." It's been slow going Harvey says, but the issues of "low cost, low carbon – all that stuff is coming together - as increasingly ship owners try to balance all this."

COMPROMISES

Meanwhile, there are several things to keep in mind about vessels: each represents a collection of compromises, says

Investors, owners and operators need to be concerned about making big financial commitments to LNG and its bunkering infrastructure. For one, associated policy changes "could easily strand all that investment." Harvey predicts hydrogen and hydrogen fuels will be online by 2030.

Ned Harvey, *a managing director, Rocky Mountain Institute/Carbon War Room*

Ashcroft, and no two are the same. Built to operate for decades, they can easily outlive the obsolescence of their chosen fueling, power and propulsion systems and technologies, and face enormous challenges in accommodating a retrofit. Every newbuild design, vessel retrofit, equipment change or placement decision is influenced not only by the regulation driving the change, of course, but more importantly, by a ship's balance, draft, dimensions, area of operation and other requirements for safety and crew well being.

Access is also key. Breaking through the ship's deck and removing or re-routing flooring, piping, wiring, support beams etc. isn't always feasible when considering engine replacement or a change in fuel source. Re-situating differently designed or sized tanks to accommodate storage of new fuel types can compromise container space, and impact safety or structural integrity. Some ships can't be rehabbed by any means. Do you scrap them regardless of age or seek to offset their carbon footprint by buying carbon tax credits? (Whether that approach is to be encouraged is the subject of much debate.) And when ordering a class of ships that will be delivered 1-2 vessels per year over a decade or more, what happens if mid order fulfillment new regulations force changes in the engine or choice in fuels or propulsion or storage?

It's a puzzle that SNAME's Ashcroft says often involves a multi-year process from the time an owner approaches a shipyard with its specifications to when it takes possession of the new or retrofitted vessel. "Ships are not designed by naval architects; virtually every naval discipline is involved in the process. Our job is to make sure it all goes together," says Ashcroft. Owners start the process by sorting through a myriad of vastly different options for lowering emissions - some current, others pending, and, hopes the industry at all levels, more to be discovered in the future.

CANDID CAMERA

In the meantime, pressure is building not just from IMO and nation state regulations – the U.S. and China already require adherence to the 0.5 sulphur cap – but from the industry's clients. Shippers that want to lessen their own carbon footprint are taking a hard look at freight logistics. There are ways to check up on the energy profile of ocean-going partners. One example is an algorithm created by University College London's Energy Institute, which uses AIS satellite data to track individual ship locations and movements over time and is able to estimate their operational energy efficiency and carbon emissions.

The Rocky Mountain Institute/Carbon War Room teamed with Rightship to launch the BetterFleet tool on ShippingEfficiency.org, which uses that algorithm to power a free tool that enables shippers, owners and investors to track and compare emissions and energy efficiency rankings of some 76,000 in-

Source: Rocky Mountain Institute-Carbon War Room

dividual vessels. RMI hopes to expand the tool to track entire fleets.

But that expansion needs funding, and preferably support from the shipping industry, which Harvey notes, is one of the least transparent sectors out there. "We will happily update it if they shared data, but no one has done that."

Some companies are taking a leading position, like shipper Cargill and freighter Maersk, in working to cut emissions. In the case of Maersk and others, Harvey says it's done mostly from a purely competitive point of view, and to that end they consider their strategies proprietary. After all, lower emissions could translate into more business as clients/shippers concerned about climate change try to mitigate their own impact.

A 'SIMPLE' RX

Other than a reduction in volume and freight, the pathway to decarbonization in shipping requires a few "simple" steps, according to Harvey: 1) buy efficient ships and retrofit them to maximize efficiency whenever practical; 2) slow down and make sure ship owners and crew are properly incentivized to maximize operational efficiency; 3) use wind assist whenever possible to reduce demand for propulsion power; and 4) switch to low carbon fuels. Implementation "will require significant coordination up and down the value chain and a collaborative effort to reduce costs of efficiency technologies and alternate fuels,'' Harvey adds. In the short-term, most owners "are going to go with whatever is least invasive," says SNAME's Ashcroft. So it's not surprising that on the carbon side, slow steaming and LNG are the most popular approaches du jour.

Slow steaming is another thing that is huge, says Harvey. It does work – it uses less fuel and cuts emissions. LNG, which contains no sulphur, virtually no particulate matter and up to 90% fewer nitrogen oxides as bunker, can run on most current engines, and there are hybrid options. "Most ships have the stability to handle the weight of Type C LNG tanks. You aren't changing the engine. Diesel engines can run on LNG. You have to change the fuel system and might have to change out a lot of machinery. It's certainly less expensive than buying new engines," says Ashcroft. A lot of new construction is dual-fuel, LNG ready. Every day brings more announcements about more orders for LNG vessels, which can be as much 25% more expensive than conventional. But each approach has its own issues.

Just because companies claim to be slow steaming, doesn't mean they are. "While talked about a lot, there

"When auto emissions were first put into place, the auto guys said they couldn't do it. But they have met or exceeded those standards. If there is a rule out there that needs to be done, the shipping industry will require some way of meeting it even if we may not understand [what it will be] today. Markets will balance."

Rick Ashcroft, *functional vice president technology and Chair of the the Technology & Research Steering Committee at the SNAME*

isn't much reason to believe that slow steaming is as common as is claimed," says Harvey, adding that the practice is hard to track and enforce. "There is very little transparency in the industry and few real incentives for the crew to slow down. It's more likely that the incentives promote faster speeds," he says, adding that speed is driven by economics, not corporate social responsibility. Ashcroft points out that hulls are optimized for specific speeds, and not for slow speeds, which could minimize any benefits from slow steaming attempts.

CATCH THE LNG WAVE

Less energy-dense LNG requires refrigeration (which requires its own energy), lots of storage in new types of tanks, different tank placement etc., all of which can pull the ship off center and cut into container space if not carefully positioned. "If you have to maintain a specific speed to remain competitive, can you afford a 10% reduction in power?," posits Barry. "Nothing is free; everything is a tradeoff in the engineering world. There are all these things you have to think of.""

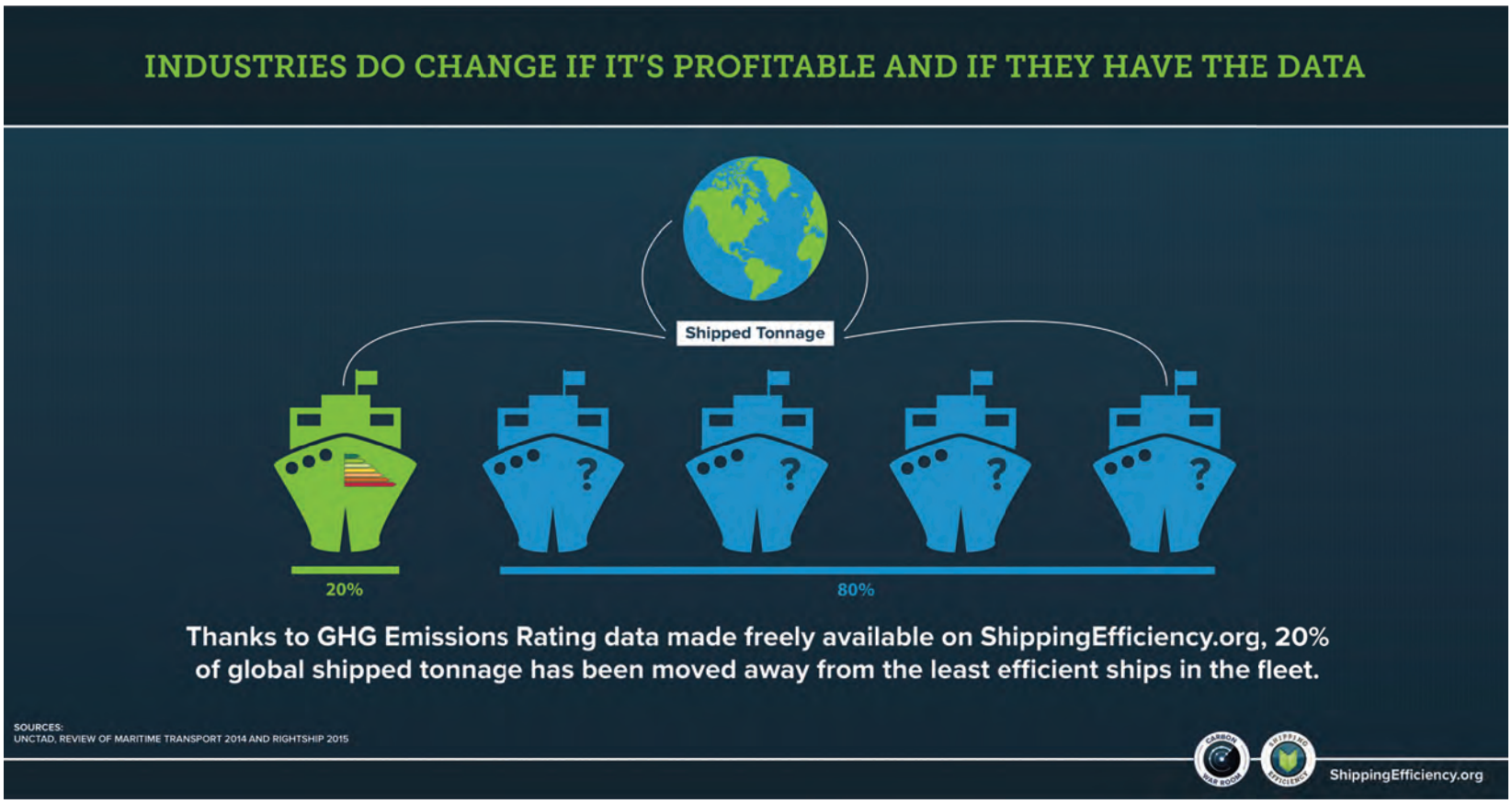
Refueling infrastructure is a significant barrier to LNG, says SNAME's Barry. Depending on where a vessel's schedule take it, it could be difficult to find a refueling source, which means a vessel might need to make room on board to carry enough fuel to support a roundtrip. (Actually, refueling and recharging are issues for multiple low- or zero emission fuel sources.)

Hybrid solutions that use LNG and diesel create another worry for owners and operators who have expressed concern about safety issues and engine failures, should fuels be mixed or crews not receive training for LNG. "There have been incidents during switchover when ships have lost power, but they do restart," agrees Ashcroft.
One significant drawback to LNG is an emission of a different kind that must be contained – poisonous methane gas - which is said to be even more detrimental to the environment than carbon. It can be captured and even recycled as a form of energy, but it's complicated, costly and still being looked at.

"LNG can provide marginal improvements on carbon as compared to HFO, but those improvements are reduced dramatically when accounting for the impact of upstream methane emissions," says Harvey, adding that methane emissions are significantly worse for the climate than burning diesel, HFO or coal. He thinks investors, owners and operators need to be concerned about making big financial commitments to LNG and its bunkering infrastructure. For one, associated policy changes "could easily strand all that investment." And advances in hydrogen fuels could make it competitive with LNG long before LNG investments are paid off.

SCRUBBERS

Another option in play today are "scrubbers," which remove pollutants from smokestacks. In recent weeks, the number of companies planning to install



Source: Rocky Mountain Institute-Carbon War Room

scrubbers has picked up noticeably. But industry opinion on the technology, which is expensive, is decidedly mixed. SOx scrubbers may be an acceptable short-term solution, but for the longer haul, low-emission fuels are a "more holistic solution," says Harvey.

As for CO2 scrubbers, ones that dump the CO2 into the ocean simply move the problem from one environment to another and are not an acceptable solution, according to Harvey. Scrubber systems that capture CO2 chemically for disposal on land could be viable, he says, except that they are "likely not scaleable or cost-effective compared to alternatives."

Separately, debate continues apace over the alternative to installing SOx scrubbers - low sulphur bunker – and whether there will be sufficient supplies, and just how considerably much more expensive it will be.

Owners may complain, but if it's an environmental regulation, it's not a question of affordability in meeting it, says Ashcroft. "When auto emissions were first put into place, the auto guys said they couldn't do it. But they have met or exceeded those standards. If there is a rule out there that needs to be done, the shipping industry will require some way of meeting it even if we may not understand [what it will be] today," says Ashcroft. "It's all part of the cost of doing business. Markets will balance." A lot of regulation results in passing increased costs to consumers, he added. This is exactly what Maersk intends to do, starting in 2020 (see related story).

BATTERIES CHARGED

One technology the industry is betting will be huge down the road, is batteries. Needed to store wind and solar energy and to store and power electricity, they are heavy and don't currently provide enough power in a small enough package to be terribly useful beyond short-sea shipping. But all-electric and hybrid propulsion-powered ferry fleets are coming online, providing the market incentive needed to push further development of more powerful, affordable batteries.

Fully battery-operated larger vessels will require "radical adjustments to how ships are operated and careful route management," warns the ICS in its "Shaping the Future of Shipping" white paper. It says the space required by the extremely large batteries needed as a primary power source could be offset by the elimination of fuel tanks and conventional engine machinery. Also needed, it says, is the development of a global recharging infrastructure with access to electricity from renewable sources. So while advances are creating a lot of excitement, the technology just isn't there yet.

True, says Harvey, who adds that costs are coming down as fast as the technology is changing. He thinks within the early years of the next decade, batteries could be a really good solution. "You might be able to run a ship around the world, charging using wind or small solar on a ship or small store of hydrogen. Now you have an almost fully renewable ship."

ALTERNATIVE FUELS

There are other carbon-emission-free alternatives, one almost nostalgic, one seemingly boundless in supply, a couple extremely

toxic. All are either still somewhat under development or searching for a cost-effective approach. Beyond those are options are those mostly still in the research and development stage, including hydrogen, ammonia, and fuel cells. And then there is the scary one - nuclear power.

Wind and solar are supplementary energy sources, and require sufficient battery storage and a primary power source.

Wind – talk about back to the future. Who'd have thought shipping would go back to its roots to harness wind power, using fabric and rotor sails (such as on the LNG vessel Grace), as well as kites? Still, wind power and other technologies that contribute to increased efficiency of conventional systems are unsuitable as the only propulsion option – albeit there is the potential for the use of wind to reduce the size and therefore the cost of the additional propulsion system.

Solar – as long as the sun is shining and you've got sufficient storage for when it isn't, solar seems like a no-brainer for vessels that spend countless hours under the hot sun. But the amount of power generated per panel would call for huge numbers of panels, the placement of which would need to take into account their weight, the presence of tugs, how you'd dock the ship and even safety issues, says Ashcroft. Beyond very small craft, solar power today only can augment other power sources.

There are vessels operating today on nuclear power. Modern nukes are expensive but also clean, "barring an accident," and fueled for 50 years, making cores "good for the life of the ship," says SNAME's Barry.

But the downsides are downright dangerous – security and safety are huge. Operators would have to protect the material in the core, protect the technology from falling into unsavory hands, and find a way to dispose of nuclear waste. It's too much for some ports, which refuse entry to nuclear vessels. If the ship is scrapped, how is the waste handled? You now have specialist scrapping requirements.

Those interested in the nuclear option anyway can buy a small, modular nuclear reactor – basically a nuke in a box. It contains so many kW hours, and when exhausted, the client has to send the box back to be recycled and refueled, says Barry.

Carbon-free ammonia comes with the same safety restrictions as propane, but has more energy than LNG and is not as hard to deal with from a pressure standpoint, and can run on big diesel engines. It's also extremely toxic. "People have figured out how to make ammonia out of air and water – but is there enough renewable energy available to fuel a merchant fleet?, asks Barry. Electricity is already successfully in use with ferries and some short-sea operations with fixed travel routes. But the sheer weight and space taken up by the batteries needed would make them untenable for longer voyages until there are breakthroughs in lithium-ion batteries.

Harvey predicts hydrogen and hydrogen fuels will be online by 2030. Hydrogen can take the form of a liquid, gas or fuel cell, and can be also be created from fossil fuels. It has a low energy density, can corrode metals and needs serious cryogenics. According to the ICS, its main challenges as a marine fuel are the cost of production, transport and storage – a by-now familiar refrain with most new marine fuel prospects. Ideally renewable, and still experimental for shipping, biofuels are problematic because they take land to grow (though specially engineered crops such as algae could change that), and could compete with food crops. There is one vessel currently sailing on vegetable oil, according to The GoodShipping Program, the container vessel Samskip Endeavour, which swapped out its usual combination of fossil fuels for treated cooking oil.

CREDITS OR CRUSH?

Some owners may decide they either can't physically make the changes or cannot remain competitive if they bring their vessel into compliance. For these owners, there is another option – offsetting their carbon footprint by either paying a carbon tax based on a variety of equations including emissions per tonne, or paying a fee to remove an equivalent amount elsewhere. Kind of like a company offsetting their footprint by planting a forest of trees.

Still other owners may determine that some vessels are too expensive to rehab, or perhaps can't be rehabbed. Maybe there isn't enough room under the hood, so to speak, to accommodate the design/structure changes required to move to different energy sources. According to SNAME's Ashcroft, we are already seeing an uptick. "A lot of relatively new ships have gone to the scrap yard in the last few years."

The ripple effect here goes beyond a business boom for scrappers. Different fuel sources will require new disposal regulations and better training of the manual labor force currently picking apart the carcasses of dead ships. Barry thinks that trend will feed into an uptick in new builds, noting some owners may be encouraged to scrap to get extra money to use to justify building a new vessel. But not just conventional builds. New fuel sources and emission-eliminating technologies and their operational and design requirements are spurring development of radically new ship designs, just as the 2017 Tripartite Forum on shipbuilding and design had called for. It said then that there was an urgent need to design future ships differently and to be more technologically innovative to achieve CO2 reduction goals.

One example, the Aquarius Ecoship, is a cargo ship devised by Eco Marine Power of Japan, which runs on a combination of wind and solar power supplemented by conventional fuels. That mix reportedly can produce up to a 40% reduction in emissions. The industry will be closely watching this and another pioneering vessels from Japanese shipping line NYK, whose Eco Ship 2030 will use LNG to make hydrogen to run fuel cells. Backed up by solar panels covering the entire ship and 40,000 square feet of sails to catch the wind, the combination could cut emissions by 70%. Possibly by 2025, shippers Wallenius Wilhelmsen hope to launch the E/S Orcelle, which will be powered by electricity, half coming directly from wind, solar and wave energy, and the other half from converting some of that energy into hydrogen to power fuel cells.

No Worries Mate!

New Fuel Rules: Behind Supportive Front, Industry Frets About Cost, Strategy, Supply

There are studies and reports from classification societies, scientific organizations and governmental agencies assuring maritime industries that carbon-heavy fuel is peaking and will be replaced by 2050, if not by 2035, with zero carbon power alternatives. No question, they chorus, shipping can meet the IMO goals of a 50% reduction in 2008 levels of GHS by 2050.

But as the hot breath of various deadlines bear down upon them, with the 2020 sulfur cap in the forefront, ship owners, operators and financiers are starting to worry aloud.

Their unease is driven by several things: regulators' banking on a belief that there will be as yet unknown discoveries that will provide solutions, a feared lack of infrastructure or supply sufficient to fuel eco-conscious vessels, and the financial burden of making the switch – especially if they choose the wrong strategy and or standards change down the road after they've committed to a solution. Oh, and those solutions will have to be geared to meet the demands of specific vessel categories, and increasingly, environmentally-conscious financiers who have requirements of their own in order to secure loans.

Among the complaints that have surfaced:

• **Engine Failure:** The potential for engine failure in hybrid vessels if fuels get mixed during the switch over.

• **Scrubbers:** One alternative to expensive low sulfur fuel, they are expensive themselves, don't necessarily fully resolve or dispose of pollutants, and are seen as a short-term investment solution that will have to be replaced sooner than later.

• **Limits:** That some options under scrutiny today are limited to certain markets, can only be used in conjunction with another solution, and or are not powerful enough (i.e. batteries and fuel cells) to be used for anything beyond short-sea shipping or specific route-bound passenger vessels (ferries and tour boats).

• **Cost:** How they are going to pay for these upgrades and changes in fuel? And which solutions will investors and insurers favor - key in an industry running on multi-millionn dollar vessels with multi-decade lifespans that take multiple years to produce. And whose greatest expense currently is fuel.

Shipping giant A.P. Moller-Maersk A/S predicts the sulfur emissions cap will explode annual fuel costs industry wide by at least $50 billion. The company expects its share will total $2 billion in 2020, and it's not willing to shoulder that cost alone. It plans to charge clients separately for fuel for the first time starting in 2020.

ING Bank announced that it will be looking to steer its clients and lending activities toward support for the Paris Climate Agreement's "well-known below two-degree goal." It will use a tool called the Terra Approach to measure "the needed shift in technology against the actual technology clients are using today and plan to use in the future." ING says banks have a responsibility to finance "positive change," and it plans to do just that, steering clients toward investments in environmentally-driven upgrades and strategies. Shipping, take note.

And, throwing a possible monkey wrench into the move toward low-sulfur last month was a group of flag states and shipping organizations, including BIMCO, Intertanko, Intercargo, Panama, Liberia and some island states, who joined together to request a "test phase" be established before the implementation of the 0.5% cap on sulfur-carrying fuels for vessels without a scrubber system. They cite fuel safety and quality concerns.

■ ***by Patricia Keefe***

Images / Renderings: CREDIT Kongsberg and RAL)

Autonomy Arrives

Excitement. Controversy. Curiosity. Skepticism. These are just a few of thoughts, and emotions that arise to any mention of the topic of autonomous vessels.

By Joseph Keefe

Futuristic, remote-controlled marine vehicles are not coming. They are here. The advent of this technology has some stakeholders pleased at that prospect, but at the same time, leaves others on the rulemaking and regulatory side equally apprehensive. It's a brave new world.

Happening Now

Ahead of the rulemaking process, autonomous technology providers already churn out not just prototypes and designs, but also countless workboats, many already in service.

Vancouver-based naval architects Robert Allan Ltd., and Kongsberg Maritime are collaborating on the development of a remotely-operated fireboat that will allow first responders to attack fires more aggressively and safer than ever before. Separately, in Korsør, Denmark, Boston-based Sea Machines demonstrated the capabilities of its SM300 product aboard an autonomous-command, remote-controlled, TUCO Marine built fireboat. Marine firefighting is an autonomous application that appears to have legs.

Sea-Machines also partnered with Marine Spill Response Corporation (MSRC) to autonomously control a Munson boat to deploy and tow a spill collection boom working in tandem with a 210-foot MSRC spill response vessel. In direct competition with Sea-Machines, ASV Global is working on autonomous projects with a similar focus. ASV recently partnered with UK's Peel Ports Group to develop autonomous vessel technology for shallow survey operations.

Another stakeholder, Florida-based SeaRobotics Corporation recently delivered two 2.5 meter autonomous unmanned surface vehicles (USVs) to the Canadian Hydrographic Service, a part of Fisheries and Oceans Canada, bringing the fleet to four systems.

More recently, towboat operator KOTUG demonstrated a remote controlled tugboat over a long distance, from Marseille, France to Rotterdam. A KOTUG captain took control of the tug via remote secured internet line and camera images, all based in Marseille.

In July, a major development saw shipbuilder Metal Shark join forces with ASV Global to introduce "Sharktech" Autonomous Vessels. Metal Shark is now offering Sharktech autonomous technology on its entire portfolio of aluminum vessels.

Naval Architecture & the Regulatory Regime

Not so fast. The devil is always in the details. For example, classification society ClassNK recently released its Guidelines for Concept Design of Automated Operation/Autonomous Operation of ships. ClassNK isn't the only IACS member to address the advent of autonomous vessels. Outgoing IACS

Pictured: The (Autonomous) Future of Marine Firefighting: Kongsberg & Robert Allan teamed on the RALamander 2000.

Chairman & DNV GL Maritime CEO Knut Ørbeck-Nilssen believes that IACS rules must "… allow for such new technologies to be used, in the interest of safety and in the interest of the working environment for those people."

As these rules evolve, flag states and registries will also have input. Tellingly, the U.S. Coast Guard led a delegation to the 99th session of the International Maritime Organization's Maritime Safety Committee. This meeting advanced discussions on vessel autonomy. Last year, the IMO agreed to assess how existing international conventions would address advances in autonomy.

Thomas Chance, CEO, ASV Global (which was recently acquired by L3) shrugs off potential regulatory pitfalls, saying, "The regulators are being careful to provide a balance of guidance without killing the industry."

But, naval architects and designers have many things to consider. If 'Dull, Dirty and Dangerous' is the catchphrase that describes the best reasons to employ autonomous technology, there are also other reasons to explore this emerging, disruptive product. One main driver is lower capital and OpEx. An unmanned vessel does not need staterooms, heads, galleys, a wheelhouse, and other spaces found on conventional vessels. That vessel is much simpler, less expensive to build and maintain. With fewer (or no) crew, daily costs also shrink.

There are trade-offs. The end-user might pay a premium for the control system, but also achieve savings in other areas. Vince den Hertog, RAL Vice President, Engineering, agrees. "There are capital cost savings from dispensing with the deckhouse, wheelhouse, domestic systems or lifesaving equipment, but these are offset by a premium for electronics, communications, sensing and operator console equipment to operate remotely. In the end, the cost difference will not be prohibitive since the capital cost of the vessel remains driven mainly by hull structure and major equipment/machinery."

Metal Shark's Josh Stickles takes a similar tack. "Take a look at the 38-ft. Defiant Sharktech autonomous vessel, for example. As configured, it's got expensive Pillarless Glass, expensive shock-mitigating seats, special flooring for sound deadening and vibration mitigation, climate control, an enclosed head, full galley, and the list goes on. We could offset a significant portion of the cost of technology today by eliminating crew amenities. A true unmanned vessel can be 'leaner and meaner.' So, efficiency is a key consideration."

Workboats vs. Deep Sea

Conventional wisdom says that the arrival of autonomous vessels in the workboat sectors will be far easier to digest than that which might be planned for the 1,000 foot boxship. After all, it was Maersk's CEO, not too long ago, who opined that unmanned vessels might happen, just 'not in his lifetime.' Yet, in a first for the industry, Sea-Machine's collaboration with Maersk could portend the coming wave of early deep-sea adopters. Sea Machines hopes to demonstrate how 'AI' technology can increase the safety, predictability and productivity of real-world shipping operations. These trials are scheduled for Q4 2018.

Also reflecting industry's deep draft appetite, in May 2017, YARA and Kongsberg announced a partnership to build the world's first autonomous, electric containership. Yara's deal with VARD could come to fruition in 2020, moving to autonomous operation by 2022.

DNV GL CEO Ørbeck-Nilssen is measured in his approach to what might come next. "I think we should first of all start by clarifying that there is a big difference between autonomous shipping, autonomous vessels, and unmanned vessels. Autonomy and high degrees of autonomy make a lot of sense because you will have more information coming to you from sensors placed on various sorts of equipment … And having that information, you will be able to a certain degree to reduce, for instance, the number of officers attending the engine room. Maybe for a tanker, we have four officers, you could possibly reduce that to three or two officers."

The Changing Workforce

Once just a vision, the autonomous vessel is here. What that means for labor is another thing altogether. ASV's Chance discounts the ultimate impact, saying, "The dirty little secret of the unmanned boat business is that it is not completely unmanned. We have talked about reduced manning, bridge aids on manned vessels, and about manning unmanned ships as they come in and out of port. There is also the maintenance of the vessels once in port. My guess is that the natural attrition of mariners due to retirement will more than offset the jobs lost due to automation."

Another firm at the heart of this rapidly developing business is Rolls Royce. Oskar Levander, Rolls Royce Vice President of Innovation, Engineering and Technology, asked recently, "Given that the technology is in place, is now the time to move some operations ashore? Is it better to have a crew of 20 sailing in a gale in the North Sea, or say five in a control room on shore?"

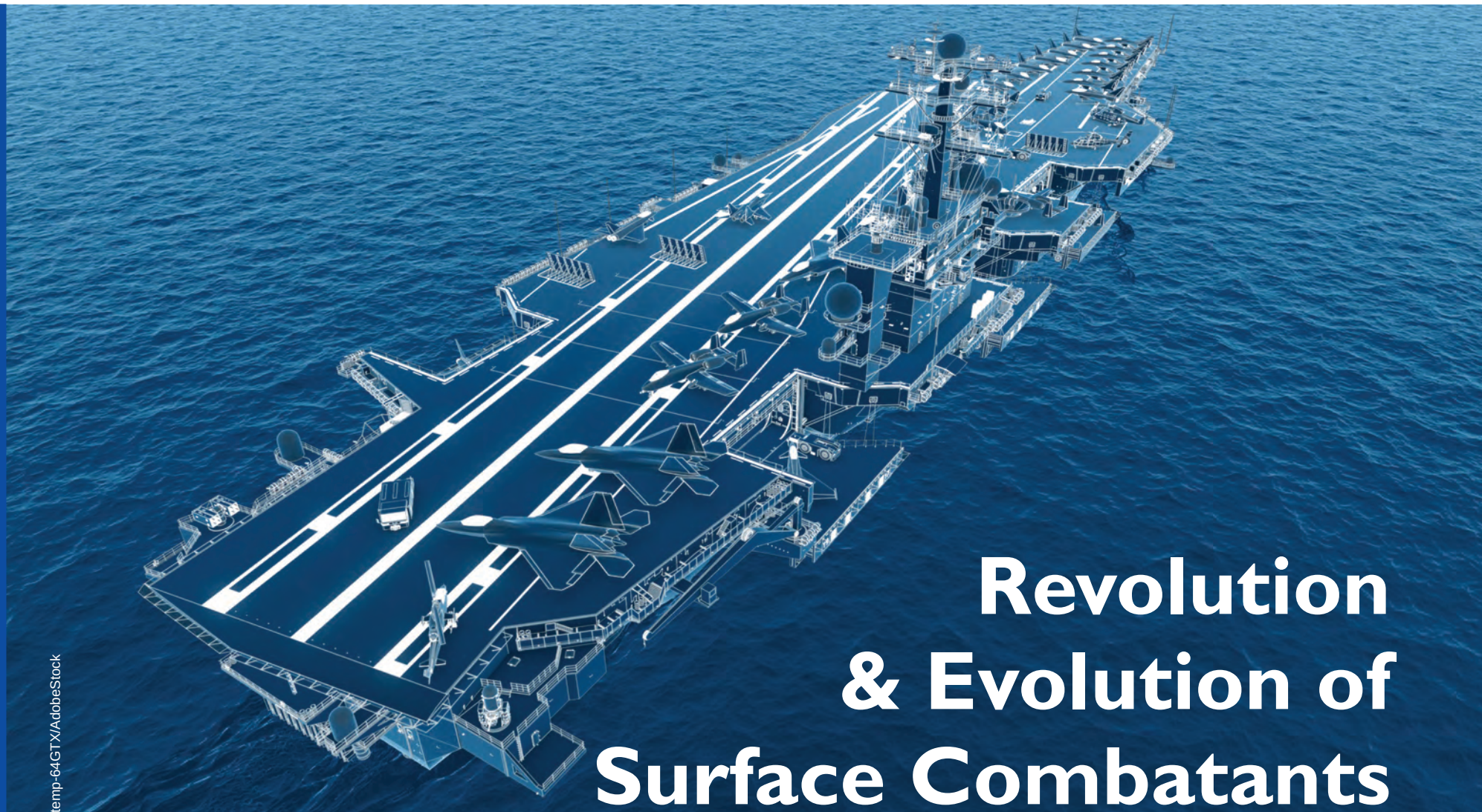
With many stakeholders hesitant to couch autonomy in terms of mariner head count, its impact on marine business going forward cannot be denied. That said; autonomy creates other jobs that will displace more traditional seafaring roles. MetalShark's Stickles said, "We agree and we haven't been shy about saying so. The largest and most immediate potential impact of this technology is crew reduction and in some cases elimination. How much safer and more effective could we as an industry be if we could reduce the risk and loss of human life while performing our missions more efficiently? Imagine, for example, if a fleet of quickly-deployable, autonomous firefighting vessels existed during the Deepwater Horizon disaster. Such vessels could be sacrificial if necessary, to get in closer than humanly possible to deliver maximum firefighting force."

Looking Ahead

Just as advances in waterborne shipping – for more than 50 years – could only be measured in the size of the tonnage being produced, so too will the ship of the future be measured by the number and quality of bells and whistles that make it float.

Vince den Hertog at RAL takes a measured approach. "Philosophically, we are also on the same page as far as setting realistic expectations for our clients and ourselves. We see autonomy being an incremental process and are both focused on practical solutions using best available technology, not autonomy for its own sake within a more futuristic vision."

Whatever your take on autonomous vessels, it isn't too late to get on board. But, you might have to wait until the next port call to do so, because, without a doubt, 'that ship has already sailed.'



Revolution & Evolution of Surface Combatants

Following the drawdown at the end of the Cold War, the Navy finds itself trying to build up again. The expansion of Russian and Chinese naval power has changed the calculus.

By Edward Lundquist

While there will always be a debate about the final number of ships to build, we can all agree on one thing: the Navy must get bigger and the demand signal is to start building now," said Chief of Naval Operations Adm. John Richardson, in testimony before Congress regarding the sea service's 2019 budget request. "The Navy (needs) a better fleet, more capability achieved through modernization, networking, agile operating concepts, and a talented force of sailors and civilians with officers of competence and character to lead them. And finally, the nation requires a ready fleet: more at-sea time, more flying, more maintenance and more weapons of increased lethality that go faster, farther and are more survivable."

A tall order indeed, with the main question remaining: From where will the money come?

Designing, Building, Maintaining the Future Fleet

For the U.S. Navy, designing and building the fleet of tomorrow has always been heavily influenced by the past and present. That goes for the technology on the ships to the industrial capacity to produce them. It takes years to build a ship from design to construction before entering the fleet, especially the first ship of a class. Making the design and build particularly challenging is the fact that a lot of technology changes from initial drawing to commissioning, particularly today with the acceleration of technology change. That's why building tomorrow's Navy will require a different approach. One critical point to always keep in mind: The industrial capacity to design, build, outfit and maintain a naval force is not a faucet that can simply be turned on and off.

Commonality Matters

The Navy is now planning for a large surface combatant and a small surface combatant, referred to as the frigate. "When we think about the distribution of our force, we need capacity, so we need some things to be big and some things to be small, and figuring out how we can balance capacity and cost and distribute those sensors and shooters most cost effectively within our force," said Rear Adm. Ron Boxall, director for surface warfare on the OPNAV staff.

The large surface combatant will take the DDG 51 Flight III combat system and place it on a larger hull, with the space, weight and power for mission growth. The frigate is also moving forward, with five industry teams under contract for conceptual work. "They're working with our program offices to mature the system specification and

the individual designs, inside the cost parameters that we're looking for to make that small surface combatant a common, networked, surface platform to do both sensing and shooting, and common to the large surface combatant and our unmanned platform or platforms," said Boxall. "We're using a lot of government-furnished equipment (GFE) systems that we already know, so we're not bringing a lot of uncertainty in." **While the frigate will leverage an existing design, the large combatant would require a new design with the appropriate size and power.**

Boxall said that unmanned systems are another way to distribute the force and build capacity. "We need things to be as small as they possibly can be, but big enough to do what they need to do." "At the small surface combatant level, that force needs to have capacity at a cost, but it's got to be able to sense and shoot and do command and control, and that just won't have as big a sensor, it won't have as much capacity to shoot, but it will still have that same common combat system," Boxall said. "So that's why commonality matters. It'll have the same radar as the large surface combatant. And the same thing if you look at the unmanned platform, it might be a sensor, or shooter, or something in between – a command and control node, but not all of those things."

There has long been the desire to create a "common hull" that could be configured as needed. The benefits are obvious, with reduced design and fabrication costs and commonality for spares and training. But the promise has been elusive. There are so many tradeoffs, that the result is a compromise that is never optimal for any one mission. There are examples of system commonality that has saved money and allowed for more efficient use of manpower, training and support.

• CGs and DDGs have similar sensors, guns, launchers and missiles.

• The replacement for the Whidbey Island class of LSDs will be based on a lesser capable version of the San Antonio class of LPD. There will be advantages in commonality, and cost savings in design and construction by avoiding an entirely new design.

• Italy and France have built their FREMM frigates with a common hull, but with general purpose and ASW variants. Likewise, Denmark's frigates and flexible support ships are basically two variants of the same common hull, with one ship designed for multi-purpose missions and the other for ASW and AAW, using the same Terma C-Flex combat management system.

There is commonality between the Lockheed Martin Aegis combat system on U.S. Navy guided missile cruisers and destroyers, and anti-air warfare ships of other allied navies, and the COMBATTS 21 system on the Freedom variant of LCS, which is based on Aegis. Likewise, the Independence variant of LCS uses Tacticos, a variant of the Thales Tacticos system found on many naval vessels. The total ship computing environment on Independence is similar to the one found on the Spearhead-class of expeditionary fast transports, both provided by General Dynamics Mission Systems.

Modularity is another way to achieve commonality. Adaptive force packages, including systems and operators like the General Dynamics Knifefish or Kongsberg MK 18 mine countermeasures systems — can operate from LCS, or another platform, such as the EPF.

Capability Evolution

For several generations of U.S. Navy combatants, the subsequent classes of ships were adapted from previous classes and carried something new forward. But the ships were not entirely transformational.

The Dealy (DE 1006) class was the first post war DE purpose-built for ASW. They were not highly capable, but they were followed by the Bronsteins. The Bronstein (DE 1037) class of escort ships had new sonar and ASW weapons, which was then installed on the Garcia (DE 1040) and still larger Knox (DE 1052) class of escorts. Everything on the 1037 was on the 1040, except the 1040 was more seaworthy. The Garcia class frigates had proven guns and ASW systems, but a new power plant, which was carried forward to the Brooke (FFG 1) class of guided missile escorts, but not subsequent ships. Like the Bronsteins, there wasn't much margin for growth. The Knox and slightly modified Joseph Hewes (DE 1078) classes had much more room. The Spruance (DD 963) class destroyers had an updated weapon system from the earlier Forest Shermans, but with a larger hull and entirely new gas turbine propulsion system. The search radars and sonars weren't new but the Mk 86 fire control system was new and the SPG-50 and SPQ-9 radars were a new leap. And the Spruance class had plenty of room, and allowance for more weight, along with great power excess, making it logical to use the Spruance platform for the Ticonderoga (CG 47) class guided missile cruiser and its

Image: Raytheon

Artist's concept of a DDG-51 Flight III with the Air and Missile Defense Radar (AMDR).

revolutionary Aegis combat system. Oliver Hazard Perry (FFG 7) guided missile frigate was a 20-year "throw-away" ship with a small crew, with no margin for more capability or more people. It was designed for open ocean convoy escort duty, but not one FFG ever performed that mission. Like other frigates, with top speeds of less than 30 knots, the FFG 7s were speed limited in battle group operations. However, the fact that it had two helicopters and received a towed sonar system made it a valuable asset. And they became a valuable utility player in battle group operations. With a shallower draft than the DDG 51s, they could enter more ports than other combatants, and were better suited for detached assignments such as maritime interdiction operations than larger, more capable ships. They lasted 35 years instead of 20.

The Ticonderoga (CG 47) class guided missile cruisers were built on the Spruance hull (the hull and engineering was almost identical). The first five CG-47s were decommissioned well before they reached their expected service life because they just couldn't be affordably upgraded with the vertical launch system (VLS).

The Arleigh Burke (DDG 51) class of guided missile destroyers essentially takes the CG 47 combat system and places it on a new hull. An effort to lower construction costs called for reducing the amount of steel required to build it. That made it compact, which reduced room to grow, and often made it difficult to perform maintenance in confined spaces. A later Flight II version was a little bigger, and the added helo hangar allowed an air detachment to be embarked. Now the Flight III version is underway, with a new sensor suite.
There are many more examples of evolutionary development, such as converting World War II cruisers into missile ships, the development of the Stand missile family of surface ship weapons, and the introduction of nuclear power for surface combatants. And this article does not focus on the emerging technologies, such as directed energy weapons and unmanned system, which will certainly alter the trajectory of surface ship development.

In most of these cases, there was innovation combined with something tried and true-revolution and evolution. That was not the case with the Zumwalt (DDG 1000) class DDGs, in which everything was new and different.

New is Old

Even the most modern warship is, in some ways, obsolete when it is commissioned. As the new DDG 1000 guided missile destroyers enter service we can appreciate all of the "new" technology that has gone into those ships. But the concept for those ships is not new.
To understand the genesis, we need to go back to 1987, when Vice Adm. Joe Metcalf, the Deputy Chief of Naval Operations for Surface Warfare (OP-03) on the Navy staff stood up two study groups—the Ship Operational Characteristics Study (SOCS) and the Surface Combatant Force Requirement Study (SCFRS)—to examine the operational characteristics required of surface combatant and how many would be needed respectively.

The SCFRS (pronounced "skiffers") report assessed and validated the numbers, types and capabilities of surface combatants needed during the coming quarter century, while SOCS studied the required operational characteristics those ships would need to meet the forecast threat.

The SOCS study took a fresh look at legal, institutional, operational and cultural factors that resulted in surface combatant designs, and the operational and maintenance practices that drove manpower requirements.
One of the ideas to come out of these studies was the "arsenal ship," which later morphed into the SC 21 (surface combatant for the 21st century), and then the DD 21 land attack destroyer. In 2001 DD 21 was cancelled but it was resurrected as DD(X). As the Navy would stop building the Arleigh Burke class of DDGs, the Navy could focus on DD(X), and a follow-on cruiser, CG(X). The contract for the first DDG 1000, now called the Zumwalt class, was signed on Valentine's Day of 2008. It was to be the first of 32 ships. They would be optimized for strike warfare to support expeditionary strike groups. That number was pared to 24, then 12, then seven, then eventually just three. As with most new ship classes, the first ship took a long time to build, with General Dynamics Bath Iron Works investing heavily in creating a facility that could build these ships.

USS Zumwalt today embodies the ideas first proposed in SOCS almost three decades ago. The ship has integrated electric propulsion (generating 78 MW of power); smooth topside spaces with embedded antennas; a high degree of automation and resilient electrical, communications and fire main distribution. Just as SOCS recommended, while Zumwalt has a bridge for conning, it is completely enclosed, and cameras and microphones provide sensory awareness for the watch team. The 80 vertical launch cells are located around the periphery of the ship for survivability. The two 6-inch guns retract into a stealth housing. It's quiet and stealthy. It has the radar cross section of a fishing boat. Automation has reduced crew size from 300 on a 9,800 ton DDG 51 to 147 on a 15,800 ton DDG 1000.
Was the investment in all that new technology worth it?

If one looks at the three Zumwalt class ships as research and development platforms, then some very useful technology has come to fruition that will ultimately find its way into future naval ships. But it's hard to look at the vision that began back in 1987, and pursued for so many years, and feel satisfaction that the vision has become a reality.
About the same time as DD(X) was evolving into the DDG 1000 program, the concept of LCS was being introduced. The littoral combat ship was supposed to be a simple platform with lots of volume for interchangeable combat capability that could address the Combatant Commanders' most significant asymmetric threats in the littoral. It was to a "truck," that you loaded up as needed. Again, it took some time to get the first few ships into the fleet, but those teething pains are behind us, and both variants (the monohull being built by Lockheed Martin and the trimaran being built by Austal USA) are in serial production. 32 will be built, and there are already a significant number of them in the fleet.

Lessons learned in developing DDG 100 and LCS will influence future generations of warships. But can we evolve and adapt fast enough to put the right ship in the right place tomorrow?

Industrial Capacity

With the current fleet size well below 300 ships, and a goal of 355, there is the issue of the industrial capacity to be able to build that many new ships. There is a dearth of domestic industrial capacity to design and build ships, and field them in a timely manner. There are only two yards building DDGs today,

two building submarines, two building LCS, and one building carriers and one building amphibs. Presumably they could make adjustments and hire the workforce to dramatically step up production.

But what about maintenance, modernization and repair?

More ships means more maintenance. Any effort to grow the fleet will also include keeping useful ships around longer. A ship with a 30-year expected service life usually has a planned mid-life modernization to bring it up to date. An additional modernization availability could keep her for another decade or more. The Navy now plans to extend the service life of the entire class of DDGs to 45 years, which means more shipyard capacity is needed to accomplish those overhauls.

The Optimized Fleet Response Plan (OFRP) was designed to align strike group deployments with maintenance availabilities training and workups and to provide predictability and stability for Sailors and families, not to mention the training commands and maintenance and repair yards.

There are just a few players who have the pier space, cranes, dry docks and shops to handles U.S. Navy ships. There are some commercial yards that could start to take on Navy work, and there are some smaller companies that could bid on contracts and go to the bigger yards for the docking or other work that requires the serious infrastructure to accomplish. But like construction, this is not something light can be turned on with the flick of a switch.

Very few yards have dry docks big enough for large naval vessels, and that includes Navy owned dry docks. There is discussion on procuring a new dry dock for the Navy. Most large dry docks today are built in China. A Navy dock would have to be made in America. But most U.S. yards don't have the ability to build a large floating dry dock. And even if there is capacity, it must be closely scheduled far in advance to fully utilize the significant investment. And while the Navy has strived to execute the OFRP, in reality the maintenance is contracted piecemeal.

Value of a Strong Industrial Base

The U.S. Navy had experience at the end of WW II to be building one class of ship, and embarking on the next improved iteration before the previous design was complete. This was possible, in part, because there was sufficient industrial capacity to have multiple shipyards working at the same time.

Fletcher (DD 445) class destroyer
175 completed / 13 canceled / 11 yards

Gearing (DD 710) class destroyer
152 planned / 98 compl. / 54 canceled / 9 Yards

Allen M. Sumner (DD 692) class destroyer
70 planned / 58 built / 6 yards

Charles F. Adams (DDG 2) class guided missile destroyer
23 built for the USN, plus three for Australia and three for Germany / 6 yards

Spruance (DD 963) class destroyer
31 built / 1 yard

Arleigh Burke (DDG 51) class guided missile destroyer
68 so far / 82 planned / 2 yards

The (R)Evolution
& the future of 'class'

The maritime industry is in the midst of a revolution, as multiple technological trends and regulatory requirements have made this a transcendent time for designing, building and outfitting the assets that move goods and people on waterways globally. Ships today are expected to hit new heights in efficiency, safety and environmental cleanliness, connected, monitored and (sometimes) controlled by shoreside personnel, an increasingly critical link in the global logistics chain. At the tip of the spear where technology and regulation meet are classification societies. Here, the heads of leading classification societies weigh in on the direction and pace of change.

By Greg Trauthwein

From the sulfur cap in 2020 to the ballast water management technology to the CO2 road map that IMO has decided on, there are many things happening on the regulatory side," said Remi Eriksen, Group President and CEO at DNV GL. While new regulation has always been a strong driver in maritime design and construction trends, it is met in 2018 by 'the fourth industrial revolution,' a digitized and data fed revolution that helping to enable step changes in technology and connectivity at a faster pace.
"One area we have been investing in is digitalization and our own digital journey, but also to help our customers make the transition to the digital world," said Eriksen.

Call it 'digitalization', call it 'big data', the trend toward employing an endless sea of data is simply the sharpest tool in the toolbox today to drive real advances in efficiency and safety. Outside of maritime, the business models of many industries – driven by the Google's, Amazon's and Uber's of the world – have been upended. While maritime is traditionally more conservative in its adoption of new tech, that business model is starting to change too, as the industry flirts with challenges including autonomy and decarbonization.

The American Bureau of Shipping (ABS) has adapted to the changing business environment by more closely aligning its operations and 'right-sizing' with industry demands. As technology and regulations move the industry to risk-based, data-centric, cyber-influenced decision making, its team today looks different. "Our team is now delivering a range of work not possible in 2013, including industry-leading projects with shipowners, regulators, equipment manufacturers, governments, academia and others on topics such as wearable technology, drones and unmanned systems, data strategy validation, condition-based health monitoring, structural digital twin development and predictive analytics," said Christopher J. Wiernicki, Chairman, President & CEO, ABS "Our digital journey is a key part of our FutureClass strategy to transform the traditional survey process, and continues program developments already underway."

The digital transformation at ABS is not theoretical, it is real at the very core of its service: survey. "Today, the connected surveyor is empowered through mobility with applications that enable both surveyors and clients to better manage the survey process," said Wiernicki. "Through

1989
Grounding of tanker Exxon Valdez on Bligh Reef, Prince William Sound.

1991
July 4, 1991: Arleigh Burke (DDG 51) is commissioned at Norfolk, VA.

1992
USS Missouri (BB-63), the last active American battleship is decommissioned.

1993
SNAME Turns 100.

"The digitally-informed survey of the future will involve a new kind of teamwork. Remote data scientists will be part of local survey teams, developing risk-based vessel advisories and digital models for surveyors."

Christopher J. Wiernicki, Chairman, President & CEO, ABS

a consolidated data model and a cloud infrastructure, clients have access to an expanded client portal and mobile applications to access to e-certificates, vessel information and the status updates to streamline the survey process. Advanced inspection technologies such as drones, robotics and wearable technology offer additional efficiencies for our clients and reduce risk for surveyors. Ultimately, the survey process will become more predictive and less intrusive; fueled by data, surveys will be driven by predictive analytics, only focused on those areas that require attention," said Wiernicki.

Arun Sharma, Executive Chairman, Indian Register of Shipping, concurs. "The future of class cannot be discussed in isolation from the impact of the 'Fourth Industrial Revolution' now taking place in the shipping industry.
This revolution means we shall increasingly be seeing greater adoption of cyber physical systems including unmanned aerial vehicles, autonomous ships, augmented reality, 3D printing, the Internet of Things (IoT), sensor technology and geo-spatial technology. With the rapid technological advancements and changing business environment; by 2030 there would be more autonomy, connected ships and greatly increased shore-based decision support system."

But Sharma warns, with promise comes potential peril.

"While these technologies will continue to transform computing into hyper-connected systems that integrate human, physical and digital environments, there are potential risks associated such as the difficulty to integrate and regulate these technologies to applicable markets in the industry."

Nick Brown, Lloyd's Register's (LR) Marine & Offshore Director, explains it simply: "For us, it's about a move to more intelligent processes, made possible by digital technologies that optimize systems and people."

"One of the most important issues today is a thorough review of existing class rules to make sure that they are in step with the rapid pace of technological evolution on the ships."

Koichi Fujiwara, Chairman, ClassNK

2003

Passing of Lester Rosenblatt, a well-known naval architect and Past President of SNAME.

2006

Delivery of Emma Maersk, first container ship to have a capacity greater than 12,000 TEU.

2013

The 18,000 teu MV Mærsk Mc-Kinney Møller, lead ship of Maersk's Triple E class, enters service as the world's largest containership. (Photo: Maersk Line)

2015

General Dynamics NASSCO delivers Isla Bella, the world's first LNG-powered containership, to TOTE Maritime

"If you look at the methods that have been present in academia since I went to school in the 1980s, we talked about neural networks, we talked about artificial intelligence and machine learning ... Now we have high capacity at good prices, creating this 'perfect storm'."

Remi Eriksen, Group President and CEO, DNV GL

A Strong Foundation

"One of the most important issues today is a thorough review of existing class rules to make sure that they are in step with the rapid pace of technological evolution on the ships," said Koichi Fujiwara, Chairman, ClassNK. "The next issue is looking at the evolution of technology as it applies to ship survey. This is our business. The shipping world is changing rapidly with digitalization, and the question is 'how class will evolve' in the future."

According to Brown from Lloyd's Register, "There is a move needed to a systems approach in the approving of an asset and class needs to be cognizant of the technology that builds into ships which will require new ways of working and greater multidisciplinary teams. More important than the development of 'individual' technologies, will be our ability to exploit innovative combinations of technology to drive new business models and applications and new ship designs."

As digitalization helps to drive smaller crews and perhaps, eventually, fully autonomous ships, "the question then turns to how all of this will affect class and specifically ship survey," said Fujiwara. Survey methods have to change in the future. With fewer seafarers (onboard ships) and more shore-control, condition monitoring of the ship will be pushed to sensors and automation, and the physical visit of a surveyor to a specific ship may not be as necessary."

Enter artificial intelligence (AI).

"Many jobs that are currently carried out by humans will be replaced with AI. In the classification business, AI is very useful to conduct some class-related jobs, but as AI gets better and better, we must discover new ways that AI can be useful in the classification business," said Fujiwara.

"Today I think that class rules are moving from a more prescriptive approach to more of a risk-based approach," said Matthieu de Tugny, COO, Bureau

"More important than the development of individual technologies will be our ability to exploit combinations of technology to drive new business models and new ship designs."

Nick Brown, Marine & Offshore Director, Lloyd's Register,

2016
The world's largest construction vessel Pioneering Spirit commenced off-shore operations

2017
World's first icebreaking LNG carrier Christophe de Margerie christened

2017
The 488-meter Prelude FLNG, the world's first floating liquefied natural gas (FLNG) project, arrived on site in Western Australian waters

2017
CMA CGM confirms order for nine 22,000 teu containerships to be powered by LNG

2018
The world's largest cruise ship, 228,081 GRT Symphony of the Seas, delivered. It has maximum capacity for 6,680 passengers.
(Photo: Royal Caribbean)

"The future of class cannot be discussed in isolation from the impact of the 'Fourth Industrial Revolution' now taking place in the shipping industry"

Arun Sharma, Executive Chairman,
Indian Register of Shipping

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> "Today I think that class rules are moving from a more prescriptive approach to more of a risk-based approach."
>
> **Matthieu de Tugny, COO, Bureau Veritas**

Veritas. "Look at the cruise industry and LNG as fuel; LNG as fuel in the cruise sector is new, and with that you have to perform a risk analysis. Based on the recommendation of the risk analysis, the ship owner and ship builder make a solution decision based on this risk analysis. You see this is a consultative approach, not a prescriptive approach. That's the evolution you can see today. That's a change of spirit."

Lloyd's Register was first out the box in offering guidance on digitally enabled ships. "Back in February 2016, LR issued the first guidance on digitally-enabled ships: 'Deploying Information and Communications Technology in Shipping – Lloyd's Register's Approach to Assurance'," said LR's Brown. "This identified the elements that constitute a digitally-enabled ship and the activities that need to take place to ensure that digital technology does not introduce a safety risk. This was followed with the introduction of the industry's first Digital Ships ShipRight procedure, which details LR's framework for accepting digital technology."

The "Perfect Storm"

While DNV GL talks a good digital game, it backs the talk with action, as nearly 60% of its R&D budget today is spent on digitalization. Eriksen sees four factors that have created a digitalization 'perfect storm.'

- Sensor technology
- Connectivity
- Computing Power
- Algorithms and Methods on top of it all to take advantage of all of the data

"If you look at the methods that have been present in academia since I went to school in the 1980s, we talked about neural networks, we talked about artificial intelligence and machine learning, but we didn't have the sensor part, we didn't have the connectivity part, we didn't have the computing power and the storage," said Eriksen. "Now we have high capacity at good prices, creating this 'perfect storm'." One project under DNV GL's guise worth watching is the ship Yara Birkland, which will be operational in 2019.

But as the 'perfect storm' continues, key questions arise regarding data integrity, security and ownership, questions that must be addressed first through the classification lens. "We are trying to make some rules regarding big data exchange; it's the same type of issue faced by the other tech giants … who owns the data?, and how can this data be used? It's a big issue," said ClassNK's Fujiwara. "So we've built up some market rules and set up a common platform with rules to govern the collection, storage and use of data."

In summing up the change at hand, DNV GL's Eriksen says it well: "Our purpose is the same, safeguarding life, property and the environment. Our core markets are the same: maritime; oil and gas, and energy. The main difference now is we are leaner, more agile, more responsive and for sure more digital than we were three years ago."

Marco Ryan, Chief Digital Officer and Executive Vice President, Wärtsilä

Photo: Wärtsilä

Marco Ryan

When talk turns to the digital revolution sweeping through the maritime industry, one need look no further than Wärtsilä, which has evolved from a shipbuilding company to an engine manufacturer, and is now embarked on a historic digital transformation led by Marco Ryan, Chief Digital Officer & EVP. We met with Ryan recently in Hamburg, Germany, to discuss the path and pace forward.

BY GREG TRAUTHWEIN

To start, please lay out the scope of your responsibilities.

At a high-level my job is to architect and deliver the transformation (of Wärtsilä) to a smart technology company. My specific responsibilities include cyber security, all of IT, all of the innovation, processes and capabilities, including working with startups and all digital product development. All of that translates into 'How do we drive value for customers through digital?' There are lots of levers that we can pull, and my job is to make sure that those five or six levers get pulled together in the right way to deliver outcomes that are tangible and real.

The terms "big data" and "digitalization" are overused. What do they mean to you?

I think it starts with a couple of principles: it's about pace and collaboration. So there are opportunities, and digitalization or big data are tools which allow you to get to an outcome. The outcome has to have value for the industry, and you can't do it alone.

So the first thing is it delivers something typically at pace and at scale that you can't do without the technology. I think one of the risks is that a lot of people talk the buzzwords but don't actually work out how to use them to derive outcomes. There's a lot of activity in digital: and it can be a very expensive mistake if you're not focused on how you pull things together.

For our industry it's about efficiency – whether that's around fuel efficiency or time to value in terms of, you know, getting container from port to port. It's about safety – whether that is crew safety or a passenger safety, it's about environmental impact. And it's also about sustainability – sustainability of their business and sustainability of the environment. So those are three themes (efficiency, safety and sustainability) that are specific to the marine industry.

What is the challenge of being an engineering company in the digital age?

Any established company – whether it's Wärtsilä or somebody else – that's being optimized for the world that it currently lives in, needs to be challenged into change, into something that tends to be much more value-based. We have some of the most talented engineers in the business, and we are by nature an innovative company. We change every generation: two generations ago, we were shipbuilders; a generation ago, engine manufacturers; and now a smart technology company. So we are, perhaps, one of the most agile, changeable companies that I've come across. I think the challenge with an engineering product-driven company is the proof points. So it's "Tell me what this outcome's going to be delivered, how safe is that outcome, and then I'll change." The challenge with the digital transformation is that all of it is hypothesis-driven: "what if we" and "let's test and learn" and "let's see how quickly we can prove whether that works."

So we created innovation spaces, environments, where we can incubate – make it safe – give people all the new skills and

MARCO RYAN ON 'DIGITALIZATION' IN MARITIME:

*"For our industry it's about **efficiency** – whether that's around fuel efficiency or time to value in terms of, you know, getting container from port to port. It's about **safety** – whether that is crew safety or a passenger safety, it's about environmental impact. And it's also about **sustainability** – sustainability of their business and sustainability of the environment. So those are three themes (efficiency, safety and sustainability) that are specific to the marine industry."*

mentoring, coaching and capabilities, and ask them to bring their business issues in. Then we collaboratively work on the business issues to derive a different solution or outcome. Typically (it's issues) they've struggled to solve over time, and they find that a new way of working helps to derive an outcome much quicker, while creating enormous emotional connection with the new world.

There are two key planks in the Wärtsilä transformation, Smart Marine & Smart Energy. What are they?

Well, they're both driven by – I know it's a buzzword but we believe it – ecosystem thinking. So this is looking at the end-to-end value chain and asking "where do we play a primary role," though traditionally in marine that would probably be in, onboard a vessel, that's engines and automation systems and navigation. And also asking "where do we need to play an expanded or new role," and that's much more lateral; that's much more about into the ports, into the cities.

Now in energy, we've said both visions are driven by a similar thing: if you have great technology and a deep understanding of the market sector, you can apply that in different ways – with new business models, with collaboration, with new ways of working – to create new opportunities. So we're taking the data, the insights, and we're trying to then explore how we go laterally, how we go into those secondary areas, to create new value propositions to help the organizations change.

Smart energy is slightly more advanced than smart marine, because the sector is already massively disrupted and a lot of the disruption has happened and the appetite and the need to change is there. Marine is a little bit more incubated and perhaps a little bit slower, but it doesn't mean that the journey isn't happening.

What are some real case examples of current marine industry transformation?

We've done a lot of innovation around safety visualization, using real-time data and virtual reality with one of the large cruise liners, taking real data and giving them visualization so they can look at sort of "man overboard and safety aspects." So that's one example of co-creation innovation with a customer.

In another we are taking our existing product set and showing what happens if you connect them together and drive efficiency and optimization. We did a trial in the Mediterranean, and we also did a trial between Rotterdam and New York where we saw double-digit fuel savings. Significant, this is real, in-hand money.

And then there are examples where we're taking forward-looking technologies and bringing them together to create new opportunity. We have taken hybrid propulsion, mixed it with situational awareness and dynamic positioning to

Photo: Greg Trauthwein

create an auto docking capability. So if you mix that with things like induction charging, as the vessel comes alongside, about 10 meters out, we are already recharging the vessel before it 'arrives.' That creates faster turnaround for the ferry. That's a real-life pilot that we've done 14 times with consistent results.

One of the things that is typical of Wärtsilä is that we want to demonstrate tangible outcomes. We don't want to just talk the hype. This isn't about a vision of automated vessels and autonomous shipping, it's about saying, 'Where is the value to the customer if you bring technology together, if you underpin it with something new, what happens, and what value does it create.' Each of those cases has a bottom line number attached to it.

Wärtsilä recently announced the Smart Technology Center. What is the vision?

It's a 220 million Euro total investment, and up front we're investing 80 million (and then there's other funding coming in to support). It's starting now – the doors will open in 2020 – and it is effectively relocating from the city center of Vaasa all of our manufacturing capabilities: the factory, the lab, everything – into a new campus, still in Vaasa, where we have physical space for suppliers, for customers, for academia, to come and co-locate. So we'll be doing R&D collaboratively, we'll be doing supply chain logistics, smart manufacturing real-time integration into supply chains, robotics, creating new ways of working.

You recently announced SEA20 – 20 cities globally, one purpose. Please explain.

This was really inspired by our purpose, enabling a sustainable society with smart technology. We looked and said 'we have a smart marine vision' – which is really about optimizing that ecosystem in the marine world. It starts with our knowledge of our products and our customers, what they want and where they're changing. But, you know, all these countries, all the conversations are around changing regulations, around environmental impact. We are all aware of the legacy we're leaving our children – or not leaving our children.

If you combine that with Smart Energy – which looks to 100% renewables future – we are well-positioned to drive and accelerate that change.

This is a digital mindset, the service design approach, and it's asking "What are the end needs? Who is the 'customer' and what are their needs?' The customer (in this case) is the citizen, the city, the environment; it's not just Wärtsilä's existing customers.

If we look at our customers' customers, where they live and how they work, we've got to take a view that looks globally and much more futuristically, and it's has to be absolutely embedded with a belief around our purpose: sustainable societies. The smart technology is part of the 'how': How you scale and how you do it quickly.

That was the starting point. Then we had some envisioning workshops where we came up with a hypothesis. That hypothesis was tested with a couple of key stakeholders and (through much work and collaboration) culminated in this Oceanic Awakening. SEA20 is a key component of that because we believe that the marine ecosystem does not just exist on the water: it has to exist as part of the port, and the ports are part of cities.

One important thing we realized was that, particularly regarding SEA20, this is not Wärtsilä's voice. This is not a project. This is not a program. This is not an investment opportunity. This is really a **movement** that says, 'We – and many other people – need to come together.' And nobody at the moment is asking for that conversation or facilitating it, so rather than say 'what a shame,' we said 'let's do something about it; let's be bold.' I mean it's a risk, right? Wärtsilä, the engine company, talking about SEA20 and the Oceanic Awakening –that's different. But it's something we're passionate about, and it's something that we **really** believe in. It's a very different Wärtsilä from two years ago.

Strunck Named CTO

MV Werften

Ballard joins USMMA

Image:

New MD in Finland

ImagTurku Repair Yarde:

Coles to lead Wallem

Wallem

Strunk Named CTO at MV Werften
Raimon Strunck (53) has been appointed as MV WERFTEN's Chief Technology Officer (CTO), taking over the newly created role on October 1. His responsibilities include project management, design, planning as well as procurement and logistics. He is a member of the senior management and reports to CEO Peter Fetten. Strunck has 24 years of professional experience in the shipbuilding industry. After studying mechanical engineering at the University of Hanover, he held various positions in the areas of project management, sales and planning, working for different shipyards in Germany and abroad. His experience includes three years at HDW in Kiel and 15 years at the Flensburger Schiffbau-Gesellschaft. Most recently, Raimon Strunck served as managing director of the Neptun Shipyard in Rostock, where, amongst other things, he oversaw the construction of 14 river cruise ships, an LNG gas tanker and multiple floating engine room units for cruise vessels.

Furgo Taps Heine as New CEO
Dutch offshore services company Fugro NV has appointed Mark Heine as CEO and Chairman of the Board of Management to succeed Øystein Løseth who has decided to resign.

Ballard Joins USMMA
The U.S. Merchant Marine Academy at Kings Point (USMMA) installed John R. Ballard, Ph.D., as the new Academic Dean and Provost. Dr. Ballard will serve as the chief academic officer and principal advisor to the Superintendent in all matters relating to the academic program and faculty. He will also co-chair the educational priority working group for the recently released USMMA Strategic Plan.

Kosonen New MD @ Turku Repair Yard
Coskari Kosonen has been named managing director of Turku Repair Yard, a Finnish ship repair arm of the Estonia-based BLRT Grupp. Kosonen joined Turku Repair Yard in November 2007. Before that, he held positions at a design and engineering company as well as at a shipyard, where he mainly managed naval projects.

Coles joins Wallem as CEO
Following the purchase of Transas by Wärtsilä, Transas' ubiquitous CEO Frank Coles has departed the newly merged company and found a spot as the CEO of Wallem Group. Coles offers a diverse background and long career in maritime, spanning law, shipping services and maritime communications. Coles replaces Simon Doughty, who announced his decision to step down earlier this year.

Vecchiolla to Lead VT Systems
ST Engineering announced the appointment of Tom Vecchiolla as President & CEO (Designate) of its U.S. headquarters, VT Systems. He will take over as President & CEO from General (Ret.) John Coburn on 1 December 2018, who will relinquish his CEO position but remain as non-executive Chairman of VT Systems. Vecchiolla holds a Master of Science in Systems Management from the University of Southern California and Bachelor of Science from the US Naval Academy, Annapolis, Maryland.

Glosten Opens U.S. East Coast Office
Seattle-based naval architecture and marine engineering firm Glosten has opened a new office in New Bedford, Mass. The office is the company's second location. Glosten said its expansion to the East Coast is in direct response to increasing client demand and opportunities in the region.

"In our 60th year serving the marine industry, we're reminded that our ability to endure is based on building strong relationships," said Glosten President Morgan Fanberg. "This expansion enables us to provide our East Coast-based clients and partners with the level of service and attention they deserve."

Kuehne GM of Bollinger Quick Repair
Matthew Kuehne was named General Manager of Bollinger Quick Repair. Kuehne is a 2007 graduate of the University of New Orleans, and since joining Bollinger in 2011 he has held the positions of Assistant Estimating/Project Coordinator, Estimating/Project Coordinator, Assistant Operations Manager and Operations Manager.

Boskalis is Exploring Biofuels
Dutch dredging and offshore contractor Royal Boskalis Westminster N.V. said it will run its vessels on a biofuel blend while working on a project to install the export cable to the Borssele offshore wind farm.

The Borssele Alpha project is being executed on behalf of TenneT and is aimed at connecting the Borssele offshore grid with the Dutch high-voltage grid.

During this project, Boskalis will run its vessels on a biofuel blend of up to 30 percent. As of last week, the large trailing suction hopper dredger Prins der Nederlanden is powered by a biofuel blend, resulting in a substantial CO2 reduction, the company said.

BSM Launches Offshore Division
In what can be construed as another positive sign for the turnaround of the offshore energy markets, Bernhard Schulte Shipmanagement (BSM) said it has set up a new business unit to focus on the oil and gas and offshore energy renewables markets. "This segment is focused on special operations and driven by different rules, so we decided to establish a dedicated expert team to specifically attend to the needs of the offshore market," said Matthias Mueller, Managing Director of BSM Offshore.

BSM's team is built to support owners and operators globally by providing

VT Halter tapped to build Bouchard ATB

VT Halter Marine secured a new contract to build an articulated tug barge (ATB) tug with an option for a second vessel for Bouchard Transportation Co., Inc. Construction of the new vessel, M/V Evening Stroll, begins immediately at the builder's Pascagoula, Miss. shipyard, with delivery scheduled for December 2019. This vessel will enter into Bouchard's fleet service in New York, N.Y to transport liquid petroleum products throughout the Jones Act Market. The new tug measures 112 feet by 35 feet by 17 feet and is a sister vessel to the previously delivered M/V Denise A. Bouchard **(pictured)** and M/V Evening Star, as well as the M/V Evening Breeze currently under construction and due for delivery during the first quarter of 2019. The M/V Evening Stroll is a 4,000hp twin screw ATB tug classed by ABS as Maltese Cross, A1 Ocean Towing, Dual Mode ATB, USCG Subchapter M, SOLAS, meeting U.S. EPA-Tier 4 requirements, and equipped with an Intercon Coupler System.

Vecchiolla & VT Systems

VT Systems

Fanberg of Glosten

Glosten

Kuehne

Bollinger

TMS, TGM Sign MoU

TMS

integrated third-party ship management services specifically to the offshore market, with services including technical management, crew management, newbuilding supervision, fleet maintenance and repair, lay-up solutions, travel services and software application solutions, all tailored specifically for this demanding industry.

BSM is currently active in the offshore segment, providing services to floating production units, offshore and wind energy units as well as flotels.

Deals & Signings

TMS, TGM Sign MoU

Total Marine Solutions (TMS) and TGM Fleet & Consulting Services have signed a Memorandum of Understanding designed to strengthen and promote the development of port specific information incorporated into TMS' Ocean Guardian product. Developed by TMS, in collaboration with Brenock, Ocean Guardian is a digital tool that provides shipboard operators with immediate access to environmental regulations around the world. The software system removes the guesswork from environmental compliance, providing operators with immediate and accurate information on regulations pertaining to a specific location. TGM, which offers global maritime waste management and carbon footprint reduction programs in 56 countries and more that 100 ports, will work in collaboration with TMS to implement mutually beneficial programs, projects and activities designed to promote the recognition of vetted port reception facilities around the world. Under Ocean Guardian's Manage Port Module, clients will be able to immediately see which ports have reception facilities vetted by TGM. In addition, TGM clients will be able to use the Ocean Guardian web-based portal to store port specific documents.

VIKING Acquires Norsafe

Maritime safety equipment manufacturer and global service provider VIKING Life-Saving Equipment A/S has acquired Norsafe, the Norwegian boatbuilder whose lifeboats are used throughout the world. The parties have not disclosed the sales price, and closing is expected October 1, 2018. Established in 1903, Norsafe produces a full range of free-fall lifeboats and fast rescue boats with davits and have supplied over 28,000 lifeboats to the global ship market over the years. Its lifeboat products are manufactured in accordance with the latest SOLAS requirements and approved by national and certifying authorities for both ships and offshore use.

StormGeo Acquires Nautisk

Weather intelligence and decision support services provider StormGeo has entered into an agreement to acquire Nautisk, a global supplier of maritime charts and publications to the merchant marine from NHST Media Group. The combination allows StormGeo to integrate routing and weather services with its charts and publications solutions.

Blount Boats Wins Ferry Build Contract

Blount Boats has signed a contract with South Ferry Company to construct a steel passenger/vehicle ferry for Shelter Island, NY. The 101'x 40' double-ended ferry to be named Southern Crosswill be built to carry a deck load of 260,000 pounds.

Main propulsion will be provided by two Caterpillar series C-18 Tier III & IMO II Certified each rated at 470 HP @ 1800 RPM. Twin Disc MG-516 remote mount, reverse gears will transmit power to 4-blade, nibral ice strengthened propellers through 4' Aquamet 22 propeller shafts. The Clark family, owners of South Ferry Company have been providing transportation between Shelter Island, New York and North Haven, New York on Long Island's southern tip since the 1700's. The Southern Cross will be a sistership to two other Blount built ferries designed by DeJong & LeBet for South Ferry, the Sunrise, Hull #311 delivered in 2002 and the Southside, Hull #323 delivered in 2009.

Dellner Brakes Acquires JHS Jungblut

Swedish-based marine and industrial brake supplier Dellner Brakes said it has acquired German brake specialist JHS Jungblut in a move that aims to strengthen the company's offering in the wind energy market, and also enable further global expansion, particularly in the Far East.

`The enlarged company will operate under the Dellner Brakes JHS GmbH brand. Kai Kölker has been appointed Vice President for Dellner Brakes JHS GmbH and will be running the company's wind business division in Dorsten, Beijing and New Delhi.

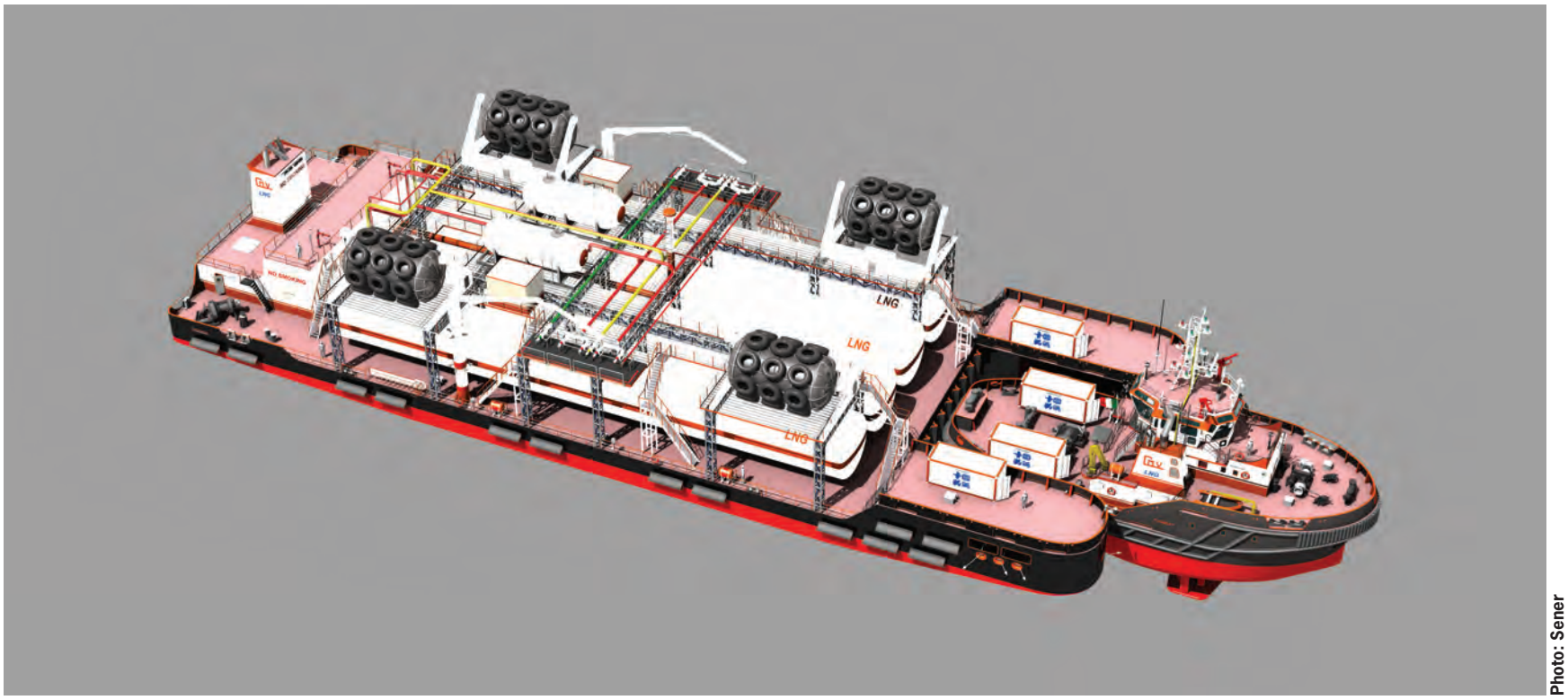


Photo: Sener

Sener-design LNG unit for Panfido

SENER signed a contract with Rimorchiatori Riuniti Panfido & C.s.r.l for delivering the basic engineering and technical assistance in the construction of a liquefied natural gas (LNG) SBBT unit, which will operate in Italy and the Adriatic.

Panfido is one of the most important tug and barge owners in Europe, with 130 years of experience in marine services. This project is co-funded by the European Union through the Poseidon MED II program.

The SBBT unit's design is a combination of a LNG fueled tractor tug (powered unit) and a LNG bunkering non-propelled pontoon of 4,000 cu. m. (cargo unit).

The tug will be designed and constructed as a dual fuel driven, towing, escorting, rescue, supply and salvage tug, propelled by Voith and with 65 tons of bollard pull.

For its part, the pontoon will have a storage capacity of 4,000 cu. m. of LNG and 1,000 cu. m. of marine diesel oil (MDO), and it will be used for bunkering service. Among other benefits, SENER's innovative design focuses on wave signature and ballast water management.

Optimizing Fin Stabilizer Operations

SKF launched a new software product for optimizing the deployment of retractable and non-retractable fin stabilizers based on weather conditions and retrospective ship's movement analyses. The company has launched its new EcoMode software, which allows a choice of three modes of fin stabilizer operation, each designed to optimize a vessel's energy consumption in line with prevailing sea conditions.

Fin stabilizers help reduce a vessel's rolling movement, thereby improving passenger comfort and enhancing the level of cargo restraint. When not required, retractable fin stabilizers are stored in a fin box. During use, however, they create drag, thereby increasing the vessel's fuel consumption. In normal practice, these types of fin stabilizer are either retracted or fully extended: non-retractable fin stabilizers, on the other hand, are permanently extended, thereby creating drag but at the same time requiring less space inside the vessel.

Optimizing Energy Efficiency

SKF's new EcoMode software provides up to three additional 'modes' of operation to cope with varying levels of ship movement and sea swells. Each mode ensures optimized energy efficiency commensurate with sea conditions, while still ensuring a safe passage. The EcoMode software delivers real-time recommendations in three modes for retractable fin stabilizers: 'passive', in which both fins are swivelled out of the fin box but not in a moving position; 'single-fin operation', in which one fin is retracted and the other is extended and operating (to avoid uneven wear in this mode, starboard and portside fins are used alternately); and 'reduced-operating mode', in which the working angle of the fins is reduced based on the ship's specific settings. For non-retractable fin stabilizers, the software provides real-time recommendations in two modes: passive and reduced-operating mode. With all of these settings both the drag and the hydraulic energy required for operation are reduced. For operation, a control panel with energy cockpit needs to be installed on the bridge and in the engine room. The EcoMode software settings can be adapted individually, for example allowing the crew to accept or decline the software's recommendations, and no further programming or adjustment from the crew is required. In the event of no response from the crew and with current sea conditions persisting, the system will issue a reminder after a defined period of time: new operating modes activate instantly on acceptance of a recommendation by the crew. Using SKF's EcoMode software can reduce fuel consumption by up to 2%, the company said. It is available for newbuilds and may be retrofitted to all SKF fin stabilizers, as well as to third-party stabilizing systems.

www.skf.com

SKF's EcoMode software allows a choice of three modes of fin stabilizer operation, each designed to optimize a vessel's energy consumption in line with prevailing sea conditions.

PropCad 2018 Premium

The latest release of PropCad 2018 Premium Edition includes a new utility to simplify the extraction of propeller features from full 3D CAD files. This new feature drastically reduces the time and effort needed to recreate an existing propeller or product model – a critical task for propeller designers and manufacturers. A process that previously took several hours can now be completed in just a few minutes.

The Import CAD File utility can be used to automatically extract geometric data from a CAD file. The user selects a CAD file in either STL or OBJ formats. The CAD models require the shaft axis to be positioned at the origin, but there are tools in the utility to rotate and translate the CAD data into the proper position with the integrated 3D preview window.

After selecting which radial sections to sample from the CAD data, the 3D intersections are calculated. PropCad's mathematics calculate the 2D section shapes and the associated parameters for chord length, thickness, pitch, rake, and skew from the intersections.

The user has an opportunity to review the derived distributions within the utility. The reference line representing the pitch plane can be manipulated to yield the proper frame of reference for the propeller's design data. The face and back offsets will automatically be calculated from the extents of the 2D section.

HydroComp is proud to release this powerful new utility as part of the PropCad Premium feature set.

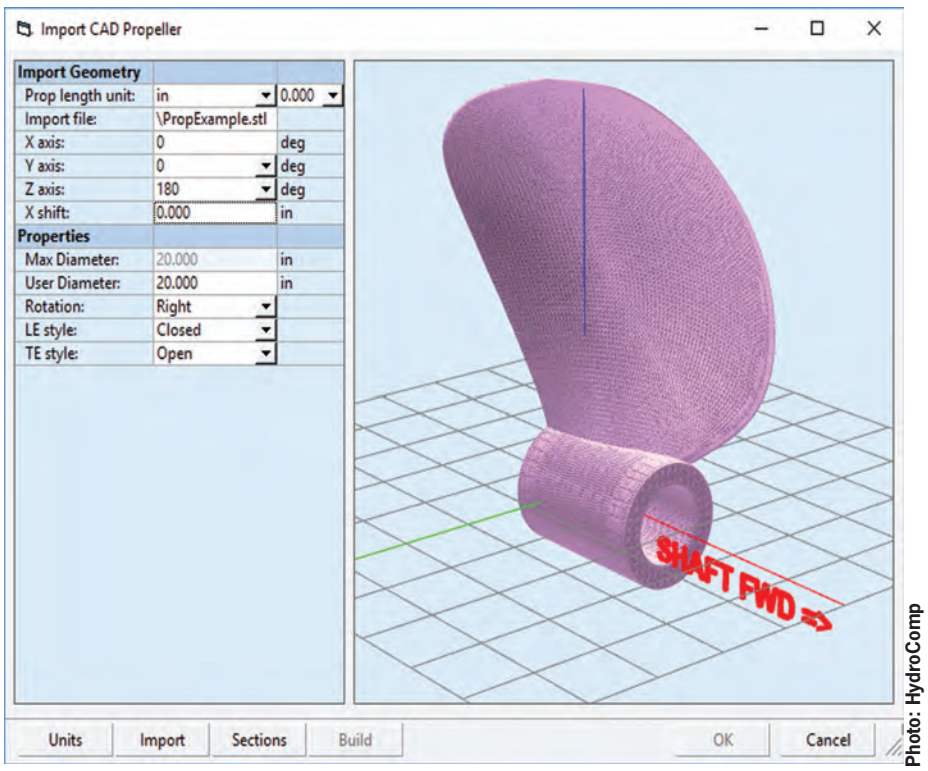


Photo: HydroComp

Photo: iNavX

iNavX: AIS Live on Mobile Devices

iNavX has launched iNavX AIS Live. Available on both iOS and Android versions of iNavX, iNavX AIS Live connects a user's mobile device to the AIS Live global network of antennas. Real-time ship movements are broadcast to the iNavX app and overlaid directly on the chart. Offering mariners peace of mind, AIS Live provides instant access to AIS data; making ships in the immediate vicinity visible without the need for a radar or AIS transponder.

www.inavx.com

The MyTaskit Mobile App

MyTaskit, a work coordination platform for marine service businesses, debuts its new mobile app, expanding on MyTaskit Pro's ability to transform how a service company coordinates work—in real time, from the field. This new app enables service companies to get more organized and in control of their business, facilitating fast, efficient views of tasks. The ability to update work orders in real-time ultimately increases productivity.

www.mytaskit.com

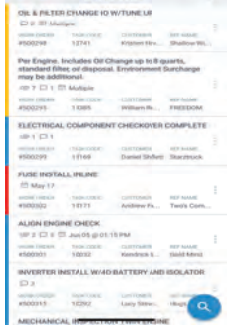


Photo: MyTaskit

Photo: SKF

Photo: GTMaritime

GTMaritime's SeaMail: Optimized for FVs

GTMaritime, a specialist in providing communication solutions to the maritime industry, has launched SeaMail - a new intuitive and cost-effective email solution that is specifically optimized for smaller vessels including fishing craft. Utilizing SeaMail's efficiencies, small vessels can communicate easily with the shore while reducing their costly satellite bandwidth usage, saving up to 80% on their satellite airtime.

www.GTMaritime.com

C-Job & Accelerated Concept Design

C-Job Naval Architects has implemented a new method to optimize ship designs. The holistic optimization method allows for quick design iterations, exciting innovations and saves the naval architect a significant amount of time.

C-Job Naval Architects is the largest independent ship design and engineering company in the Netherlands. The company employs over 130 in-house maritime engineers and naval architects in four offices and specializes in different sectors including dredging, heavy lift, offshore (wind), ferries and superyachts. From the first concept vessel design, through the basic and detailed engineering packages, C-Job's naval architects aim to produce innovative and sustainable solutions for the global maritime industry.

Instead of the classic design spiral, C-Job has implemented a new way of working in the concept design phase: The Accelerated Design methodology. This new holistic ship design method considers all ship design aspects simultaneously, which is possible as every aspect of the design circle (See Figure 1) has been automated at C-Job. The automated design circle gives the company the possibility to optimize any concept design.

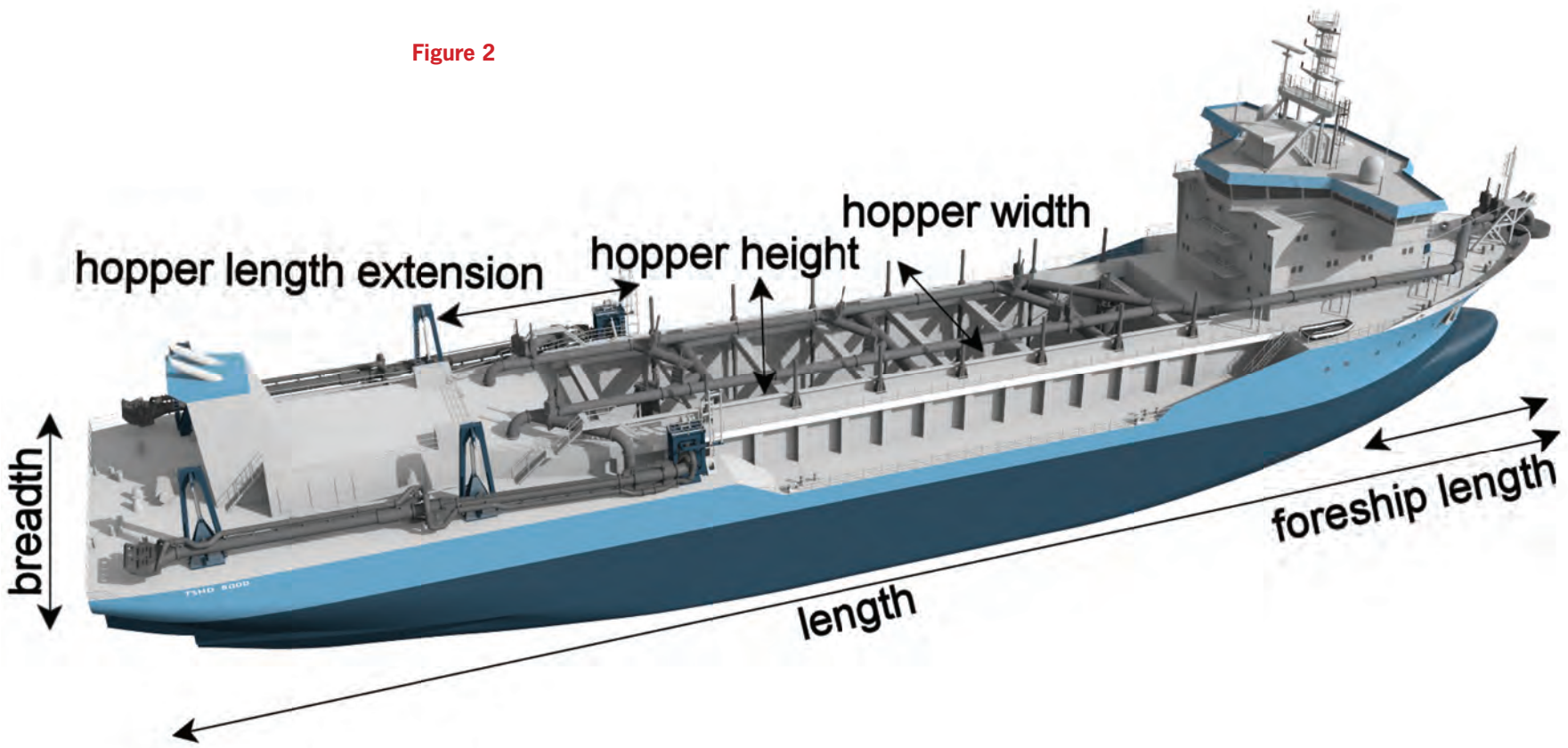
The optimization process can start after a naval architect has created and parameterized a concept design (See figure 2). The software then tries different combinations of the decision variables. Aspects that can be improved for example are total cost of ownership and environmental impact. The software optimizes the concept design by changing the hull shape, geometry and compartmentation. It does this in such a way that the design still complies with all requirements imposed by physics, the regulating authorities and the client.

Figure 1

Because it is impossible for a naval architect to consider all the dependencies between the decision variables, the constraints and the objectives, the optimization process is guided by an optimization algorithm. The algorithm used at C-Job is CEGO (Constrained Efficient Global Optimization). CEGO is developed by C-Job's data scientist Roy de Winter in close collaboration with the Leiden Institute of Advanced Computer Science. Because CEGO is very efficient and is able to model the optimization criteria and the constraints, it suitable for optimization of ships. By using the optimization algorithm, the human is taken out of the loop which saves a great deal of repetitive work and allows the algorithm to come up with exciting innovations.

The result of the optimization process is a collection of optimized design variations. The collection typically consists of multiple optimal designs. Where one design might be cheaper to build but more expensive to operate while the other design might be more expensive to build but less expensive to operate. In consultation with the client, one of the optimized designs is chosen. For the chosen design, the general arrangement, hull, geometry and the compartmentation are drawn in more detail. This more detailed design can then be used for the next stage in ship development. For more information on Accelerated Concept Design, email **info@c-job.com**. For more information on C-Job, please visit www.c-job.com

Figure 2



Images: C-Job Naval Architechts

UV-C

Keeping Ship Hulls Biofouling Free

By Niek Hijnen, **Technologist, Coatings Technology, AkzoNobel Coatings;**
& Michel Jongerius, **Senior Scientist, Philips Research, Royal Philips**

The presence of biofouling on the hull of a ship increases the drag from the water during sailing and thereby the fuel consumption, which results in increased CO2 emissions as well as increased costs for the ship owner. Paints applied to the underwater areas on the hull of ships therefore often contain biocides to hinder biofouling growth or possess non-stick properties, allowing a release of the fouling when the vessels pick up speed.

AkzoNobel is working with Royal Philips to develop a new technology that employs a completely different approach to traditional paints used in biofouling control on ship hulls. It uses an ultraviolet-C (UV-C) emitting layer applied on the underwater areas of the hull to keep the surface clean from fouling. The UV-C irradiation inactivates or kills microorganisms through absorption by their DNA, a property regularly applied in water and air purification systems, preventing the attachment and growth of biofouling.

This new approach has demonstrated a capability to keep the surface completely clean from any biofouling (Figure 1), a level of fouling prevention not offered by the current paint systems. This is the case both when the ship is sailing and when it is docked. Stationary prototype tiles have been tested around the world and have been shown capable to remain clean in various locations that are known to pose a high fouling challenge, like Singapore and the Great Barrier Reef in Australia. In addition to reducing CO2 emissions by offering unparalleled antifouling performance, the technology is a biocide-free and zero-VOC solution, which are other important sustainability objectives.

The UV-C is emitted from UV-LEDs, which are embedded in a silicone light-guide that helps in distributing the irradiation across the surface. Prototypes are currently tiles of 30x30cm2 with a thickness of 10mm, and they have a cable hardwired in for powering. To optimize the area kept clean by the individual LEDs, they are configured such that they emit sideways into the plane. A portion of the emitted light is guided along the surface by the light-guide, which can be demonstrated with an external green laser with its beam incident on the side of the panel (Figure 2).

Figure 1
UV-C prototype kept clean from biofouling in the harbor of Melbourne (Australia). On the left a benchmark silicone panel is located without UV-C, which is completely bio-fouled (courtesy to Defence Science and Technology group for testing).

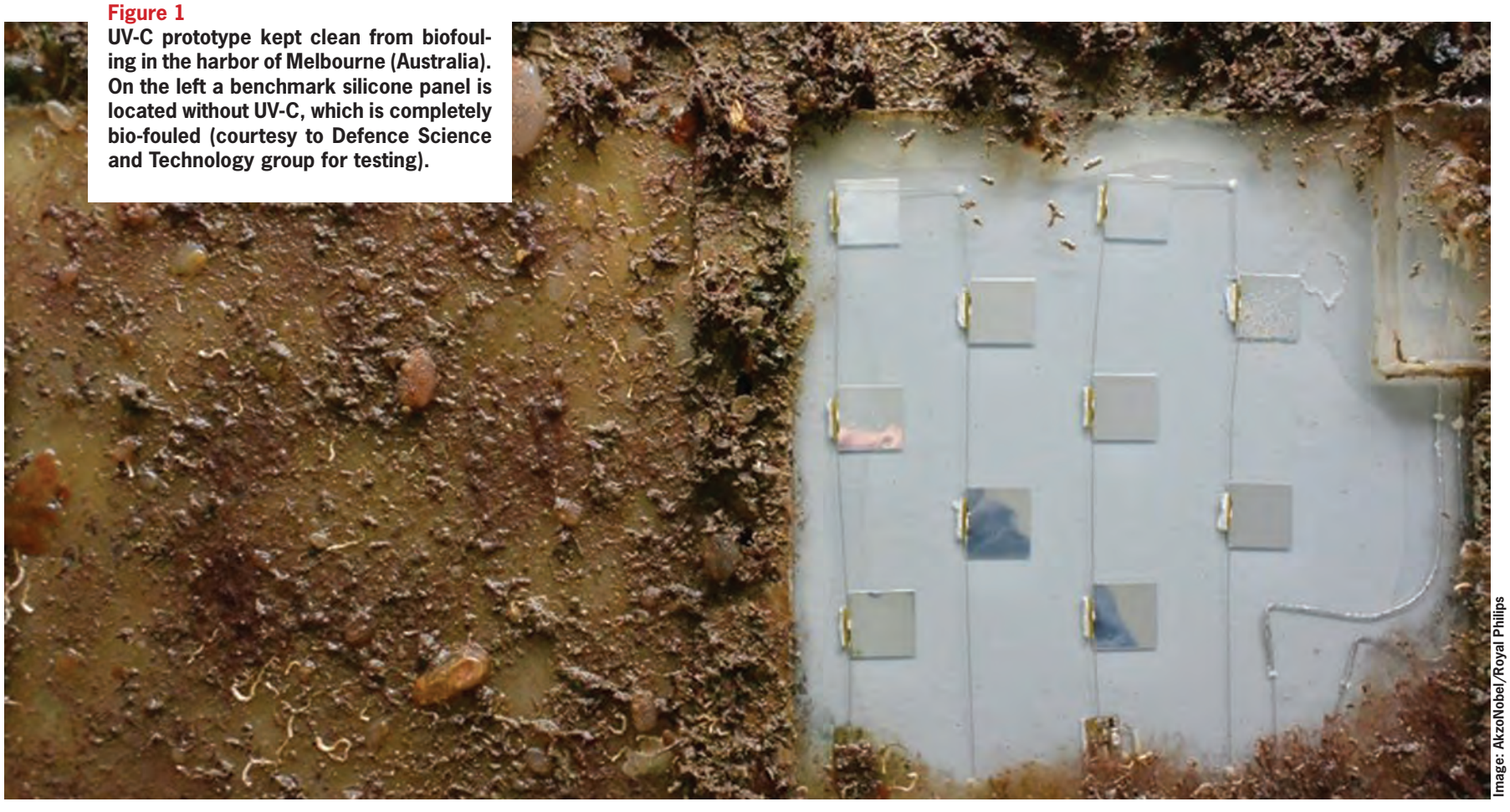
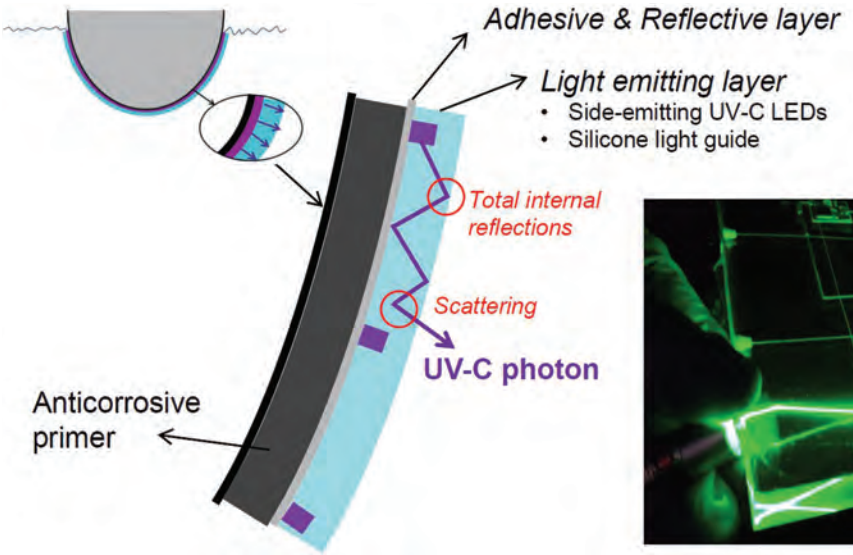


Image: AkzoNobel/Royal Philips



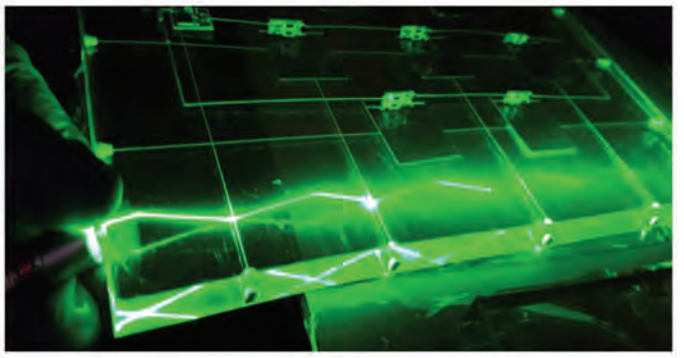
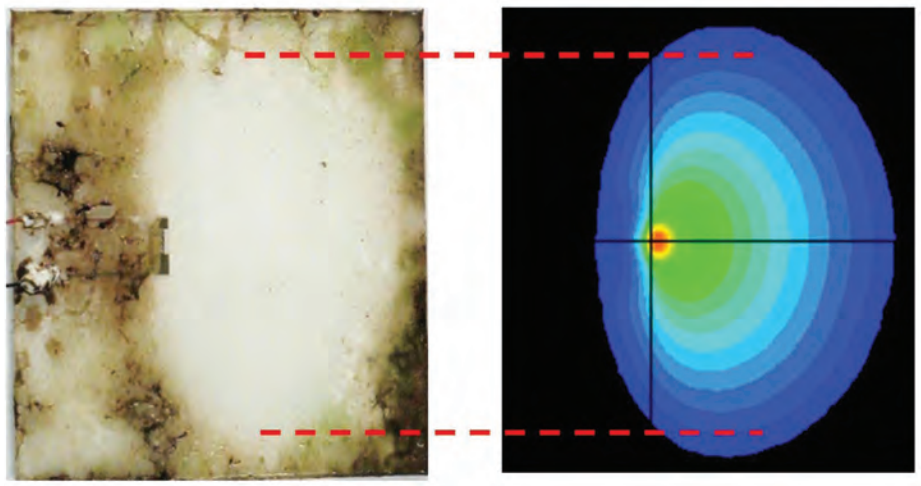


Figure 2 (right)
Schematic illustration of the working principle of the UV-C concept. On the right, the principle of waveguiding in a test panel is demonstrated.

Figure 3 (below_
Comparison of model simulations of the UV irradiation at the surface with corresponding biofouling tests. On the left for a silicone slab with a single LED, tested in an aquarium. On the right for a full prototype panel tested in sea condition. The red lines mark locations with 0.3mW/m2 irradiance level predicted from simulation.



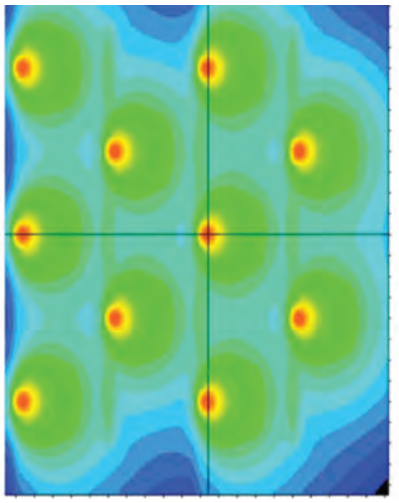


Image: AkzoNobel/Royal Philips

In the current design, reflective material is applied at the bottom to reflect the UV-C outwards, while some of it bounces back through total internal reflection at the silicone-water interface. Part of the UV-C being guided along the surface can exit the light emitting layer towards the outer surface through diffuse scattering, enabling UV-C exposure of the bio organisms at the whole surface. Knowing the properties of the components, the materials used and the design of the tile allow a model simulation of the UV-C irradiance levels across the surface. By linking data from a single LED test sample with experimental fouling exposure observations, it was found that a low UV-C intensity of only about 1mW per m2 is found to be already sufficient to prevent biofouling (Figure 3 left panel). Subsequently, this threshold value can be used in model simulations towards designing a multiple LED containing light emitting layer, ensuring that positioning of the LEDs and other design parameters are such that the entire surface is being kept free of fouling (Figure 3, right panel).

Ultimately, on a ship, the technology will be applied under challenging in-service conditions. Additionally, components within the UV-C emitting layer may at certain locations be exposed to high UV-C irradiation levels. Material selection therefore becomes critical when having to take into account durability, processing and fabrication, as well as the overall design criteria associated with the technology. Despite these difficulties, a recent prototype has already shown to be still performing well after nearly two years of continuous operation in the field.

The bulk of the light guide is made up of silicone, which, when properly formulated, can exhibit a high UV-C transparency with a transmittance of about 80% per cm at 275nm wavelength. This property is critical for the performance of the technology, as it enables distribution of the UV-C across the surface to reach everywhere the relatively low intensity levels that keep the surface clean with the use of a limited number of LEDs. While being fairly flexible, aiding the application to curved surfaces, the silicone layer also protects the electronics embedded within. Mechanical testing of the prototypes has demonstrated that the electronics within the light guide can survive typical impact forces associated with water slamming or rubbing by fenders.

An adhesive backing will be used to fix the light emitting layer onto the hull of a ship. While currently, prototype designs are relatively thick (10mm), ultimately, designs would be closer to typical laminate films. Still, a careful selection of the adhesive solution is required. To this end, aside from laboratory testing, dedicated field testing is being done to assess the performance of the adhesives and ensure that the light-emitting layer stays in place.

New generation prototypes that are under development will have a thinner design (~4mm), with no hardwired cable, and provide a larger panel size (about 50x50 cm2). The format is enabled by newly available UV-C LEDs with a thin side-view package, which can be used directly for emitting in the plane without requiring the extra step of mounting the package sideways. Inductive coupling by placing the edge of a tile on top of a power strip will be used for powering the LEDs, omitting the need for a hardwired cable to connect each tile. Additionally, improvements in materials will be applied to avoid artefacts from stresses arising due to changes in material properties during processing. Next steps in moving the technology towards the market will be developing a scalable fabrication, extending product lifetime, and the actual full-scale application on vessels. New prototypes will be tested on operational vessels as assemblies of tiles rather than with single tiles. This will help with allowing in-field installation procedures to be optimized, while the in-service use allows building a performance track record. With having achieved two years in-field performance, further improvement can certainly be expected. Gradually further improving the UV-C LED performance (lifetime, efficiency) will be the basis to come to future product solutions.

Combining capabilities from both companies, readying this technology for the market is now a global team effort. Where Royal Philips has expertise and intellectual property (IP) in designing systems using UV-LEDs, AkzoNobel has expertise in materials chemistry, adhesion and surface protection. Development of the system involves activities occurring in the U.S., Europe and Asia, and while ship hulls are the main application area that is targeted with the current efforts, possibilities for this technology also exist in niche area applications, such as sea chests. Overall, the technology offers unparalleled fouling prevention performance as well as benefits to sustainability targets, although a big challenge lies in getting it to work in the market, since it is so different from conventional solutions. Ultimately, collaboration and education are critical to making this novel and new technology a success in the marine industry.

Polyflake Coatings

Protection against chemical, mechanical and galvanic corrosion. By Lisa Overing

Corrosion starts from the inside out. The alkali that neutralizes acid water - and the acid water produced in a gas scrubbing system - are corrosive. Containment surfaces resistant to both alkali, acid water and their combination provide a safer ship with less expensive maintenance.

While selecting metal alloys as more resistant to either acid or to alkali, facing all conditions simultaneously is problematic, as temperature plays an important role in pitting corrosion.

Ultimately, leaking occurs within weeks, producing a hazardous, corrosive fluid compromising any equipment with a contact surface as well as exposed personnel.

Leakage repair is expensive with potential collateral damage, insomuch as yard repair sessions can quickly spin into a refit gone rogue.

The Polyflake coating resins system protects the base metal from alkali and acids on the full range of Ph variations found in a gas scrubber system, in the temperature range where more expensive metal alloys may fail for pitting.

“Applying Polyflake creates a plastic tube within an aluminum tube,” said Capt. Dirk Sachse, master of M/Y Themis, a 156-Trinity.

After several Trinity megayachts experienced degradation of aluminum materials in the sea chest and exhaust piping, Capt. Sachse looked for a new solution versus cutting out the exhaust and replacing.

“There were various theories out there, including galvanic corrosion” said Sachse. “We did our own metallurgical tests and it was all 5083, 5086 good quality pipe, just as specified on the drawings. It was verified good stuff, but prone to breaking down under a certain temperature.”

Capt. Sache needed to replace the large engine dump, port and starboard, dividing the wet exhaust from dry exhaust dumps. He considered installing straight pipe, but began pondering coatings.

“This is not ceramic that lifts and keeps peeling,” said Capt. Sachse, adding “Polyflake is more like a plastic tube, plastic coating. I figure what can it hurt? It’s described as a five-year product with a 20-year life. It has been used extensively in the commercial market throughout Europe. Joerg Scheele of e4Power and Polyflake has hands on knowledge as an engineer at sea. He has seen ships fail and rebuilt systems to prevent subsequent failure. I have total respect for him.”

Polyflake was originally developed for restoration of damaged and corroded equipment, pumps and heat exchangers, and submerged hull, piping, decks and tanks requiring corrosion protection. The verified operational life, in continuous seawater service, exceeds 25 years without degradation of the performance, according to Gianfranco Lucignani, Polyflake’s vice president of business development.

“Since 2015, we applied Polyflake on alkali storage tanks for Royal Caribbean Lines (RCL) Oasis and Allure of the Seas, Celebrity’s Solstice, Eclipse, and Silhouette,” said Lucignani, remarking Norwegian Cruise Lines (NCL) has applied Polyflake to its discharge line to protect the carbon steel piping with a consistent reduction of coat in respect to exotics alloys.

Lucignani said applying Polyflake coat to diffusers and overboard discharge pipes for gas scrubbers systems protects hull corrosion from the acid plume formed during load transfer, citing several cruise lines, Celebrity and Grimaldi amongst success stories.

A critical phase to the success of Polyflake coating is proper primer with an abrasive profile; a rough grind allows the base product to bite on. High voltage instruments test for minimal porosity on the coating.

One unique property of Polyflake, according to Capt. Sachse, is Polyflake has the same coefficient of expansion as the aluminum. “It could be the same for fiberglass, I don’t know,” said Sachse. “As aluminum heats up, it shrinks and expands. Polyflake does, too, but ceramic Polymer doesn’t.”

Capt. Sachse applied Polyflake to all main engine exhausts, generator exhausts, sea chests and any point where seawater where was injected, mixed with saltwater and discharged. He did not resurface valve flanges, no machining of contacting faces was required for Polycoat application.

“We have increased the lifespan of these valves and just did the bilge area,” said Capt. Sachse, adding “ABS was all for it.” He is also considering Polycoating the chain locker and lazaarette, and other difficult to maintain areas prone to corrosion.

Image: Polyflake

Marine Propulsion

New Engines, Thrusters & Transmissions Lift Ship Performance

Edited By Tom Mulligan

With an emphasis on performance, efficiency and safety, the major motive power, propulsion and transmission systems makers are competing to be at the forefront of propulsion tech development.

MAN Energy Solutions: Research engine for investigating LPG operation at the MAN Research Center Copenhagen in Denmark. See feature on page 30. Photo: MAN Energy Solutions

Photo: MAN Energy Solutions

The B36:45 LNG-fueled engine from Rolls-Royce is available in six-, eight- and nine-cylinder in-line configurations and a V-12 version is now under development, which will be followed by a 20-cylinder V-engine for very-high-power applications.

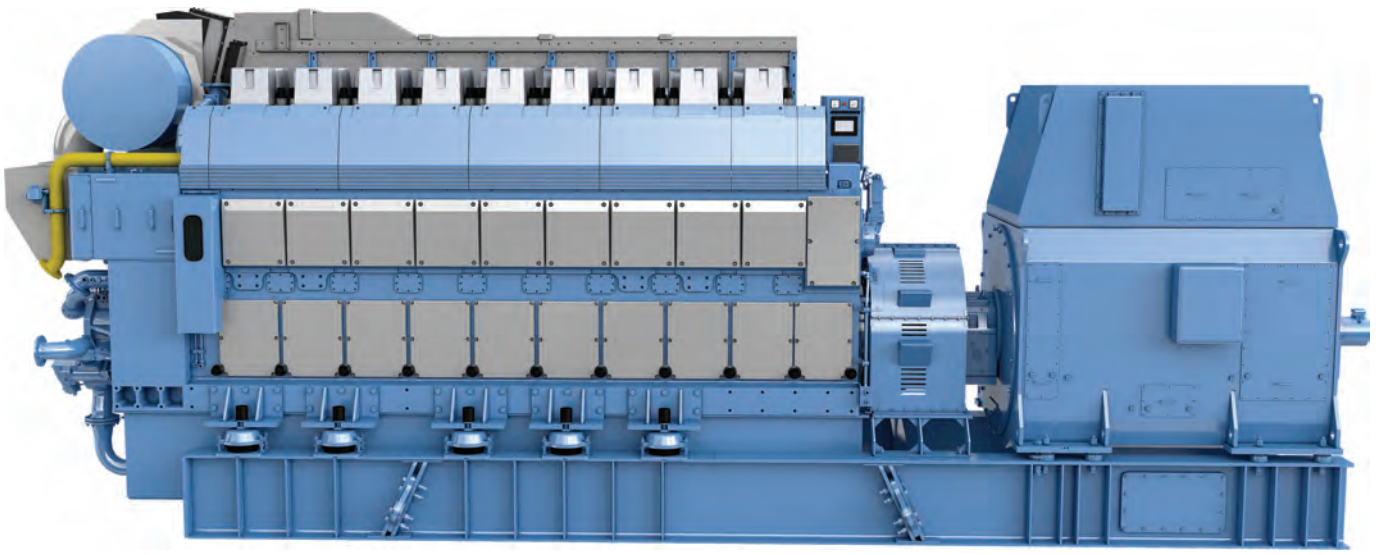


Photo: Rolls-Royce Marine

Rolls-Royce launches Bergen B36:45 marine gas engine

Rolls-Royce launched the latest in a series of LNG-fueled marine engines, the Bergen B36:45 model, which is designed in accordance with the company's 'common platform for all fuel options and applications' approach. The power output of the new engine is identical to that of the liquid-fueled B33:45 at 600 kW per cylinder at 750 rpm. Specific energy consumption is a low 7300 kJ/kWh and specific lubricating oil consumption is less than 0.4 g/kWh. The B36:45 is available in six-, eight- and nine-cylinder in-line configurations and a V-12 version is now under development: this will be followed by a 20-cylinder V-engine for very-high-power applications. Rolls-Royce's lean-burn Otto cycle combustion B36:45 technology was developed during experience in working with LNG-fueled engines to minimize methane slip. Big picture, the company claims the latest Bergen gas engines can achieve up to 22 percent lower greenhouse gas (GHG) emissions than the equivalent diesel-fueled version. For the gas version, different liners, pistons and heads are employed, giving a 30 mm increase in cylinder bore compared with the existing, liquid-fuelled B33:45. The stroke remains unchanged at 45 cm.

www.rolls-royce.com/products-and-services/marine

Drive Tech for Smart, Green Ops

Japan-based robotics automation and systems engineering specialist Yaskawa is a leading developer of advanced drive train technology and has delivered more than 1,000 marine power drives to customers over the past decade. Its Finland-based subsidiary, Yaskawa Environmental Energy/The Switch has used this drive expertise to create what the company believes is a game-changer for smarter, greener maritime operations, the Switch DC-Hub.

The Switch DC-Hub allows any potential power source to be easily connected to a vessel's DC grid, enabling shipowners to tailor the optimal energy mix for their purposes. As well as this flexibility, the technology offers simplicity by eliminating the need for a main AC switchboard and gives reliability and cost effectiveness, according to Yaskawa. The DC-Hub allows vessel generators to run at optimal efficiency, as batteries take the strain of any necessary load changes, thereby cutting back on fuel consumption, maintenance requirements, operational costs, and environmental impact. In addition, if batteries are connected to DC-Hubs, they can be utilized as standby power sources, enabling generators to be turned off entirely.

Redundancy is provided by The Switch's unique Electronic Bus Link (EBL) breaker, a key component of the DC-Hub, enabling faults to be isolated in microseconds. Fitted between a vessel's DC-Hubs, it rapidly splits the grids, regardless of the nature and scale of the fault, to ensure availability of power, and safe, efficient on-going operations. The Switch EBL recently successfully completed its first Factory Acceptance Test (FAT) in Trondheim, Norway, supervised by DNV GL and Yaskawa Environmental Energy/The Switch is currently in the process of developing its R&D capabilities to allow for drive train testing of up to 15 MW.

Yaskawa Environmental Energy/The Switch has now signed a contract to provide 16 DC-Hubs and 32 frequency converters for a new shuttle tanker concept developed by Teekay and Wärtsilä. Four tankers are being built by Samsung Heavy Industries in South Korea, with Yaskawa Environmental Energy/The Switch having begun deliveries to Wärtsilä in September of this year.

According to Asbjørn Halsebakke, General Manager, Norway, The Switch DC-Hub technology is "a key piece of the jigsaw", he said, stating that it provided absolute redundancy and system availability while eliminating the need for an AC switchboard. "This lowers both the initial system investment cost and long-term operational expenses," he said.

Yaskawa Environmental Energy/The Switch said that the lightweight frequency converters, eight in each ship, were designed to provide reliable system performance and that the DC-Hubs

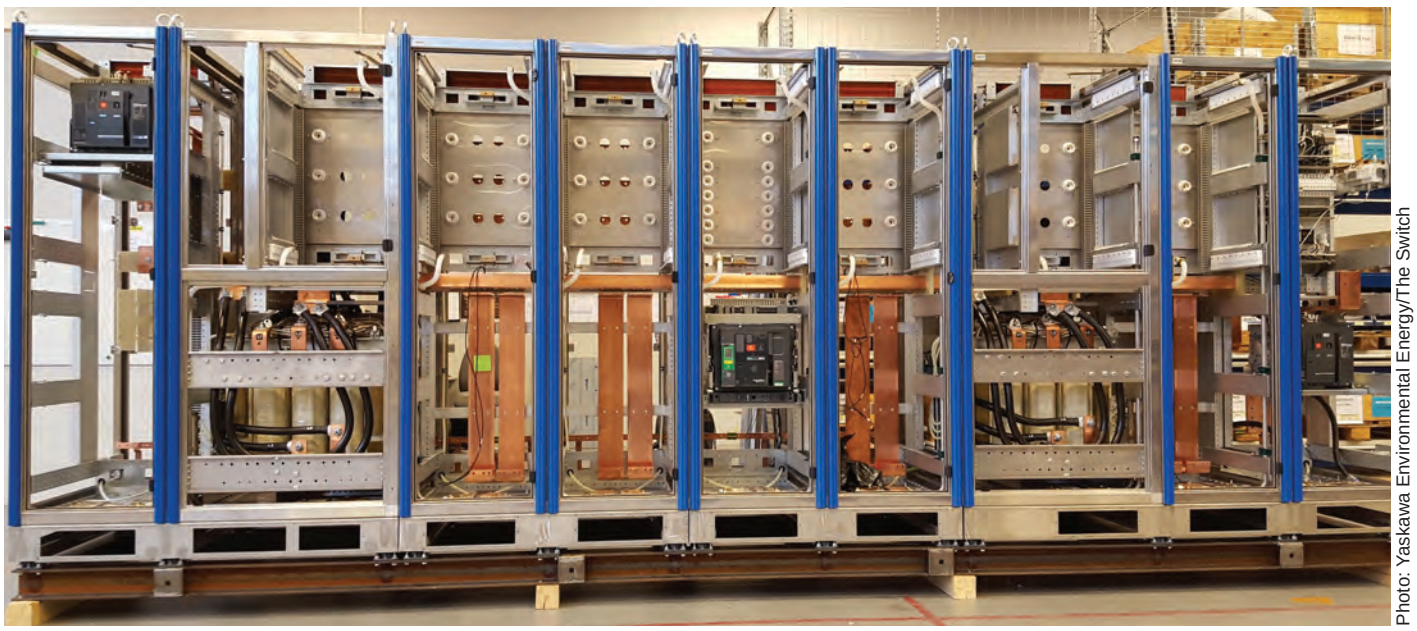
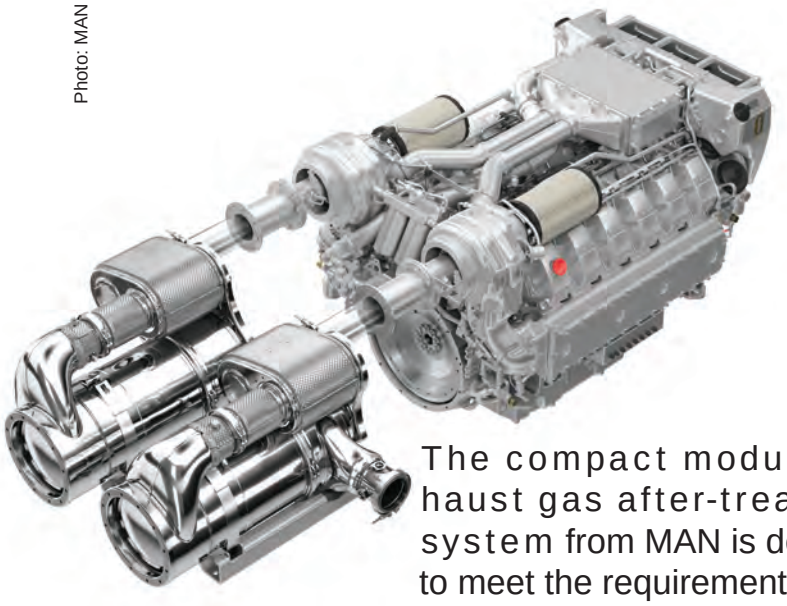


Photo: Yaskawa Environmental Energy/The Switch

The Switch DC-Hub allows any potential power source to be easily connected to a vessel's DC grid, enabling shipowners to tailor the optimal energy mix for their purposes.

Photo: MAN



The compact modular exhaust gas after-treatment system from MAN is designed to meet the requirements of both IMO Tier III/EPA Tier 4.

Rolls-Royce will be offering complete hybrid propulsion systems from MTU for ships, including engines, electric drives, transmission, batteries, monitoring and control systems.

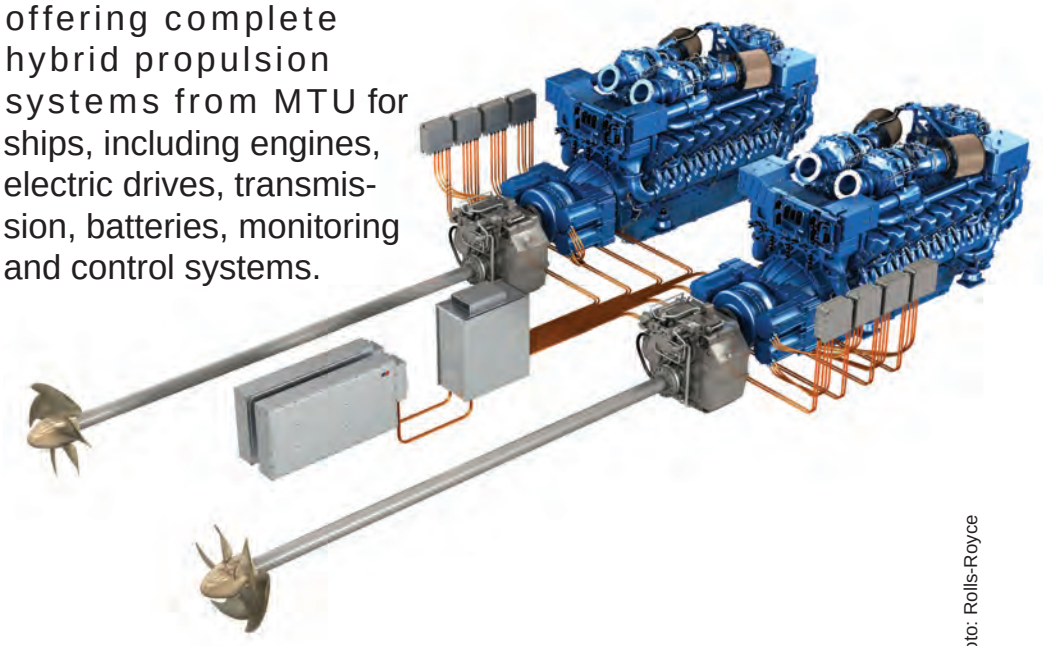


Photo: Rolls-Royce

were a key component in enabling Wärtsilä's hybrid solution, which uses batteries for fuel savings. It emphasized that any energy source could be connected to the DC-Hub. Watch an interview with Asbjørn Halsebakke at:

https://www.marinelink.com/videos/video/modern-flexible-power-for-commercial-ships-100273

MAN: Meeting IMO Tier III in Workboats

MAN Engines introduced its solution for meeting the IMO Tier III and US EPA Tier 4 emission standards for commercial use, the modular exhaust gas aftertreatment system (EAT). The system is designed to be compact and flexible to accommodate a wide range of installation configurations.

The centerpiece of the SCR is a catalytic converter that helps to reduce NOx emissions. To achieve this, a 32.5% aqueous urea solution (AdBlue) is dosed in an SCR mixer and then injected continuously and directly into the exhaust tract. The solution then reacts with the nitrogen oxides and converts them into water and nitrogen. The injection method does not require compressed air, which provides another saving on space and reduces the complexity of the system.

Combined with the optimized combustion performance of MAN engines, the SCR catalytic converter meets the requirements of both emission levels IMO Tier III and US EPA Tier 4. Using the SCR results in specific fuel consumption being additionally reduced by up to 8% per engine while maintaining the same power output.

In the marine sector, the SCR system is currently proving its practicality in field trials for commercial workboat applications. The MAN SCR system also meets the requirements of the US Tier 4 emissions standard, which permits a NOx limit of 1.8 g/kWh and a particulate emissions limit of 0.04 g/kWh. The regulation has been in force since October 2017 for all U.S.-flagged commercial vessels with an output of more than 600 kW (816 hp) per engine and equates to a reduction in NOx of almost 68% compared to the previous standard, U.S. Tier 3.

With its 12-cylinder engines, MAN Engines currently offers a consistent range of outputs from 551 to 1,066 kW for the US Tier 4 emissions standard and up to 1,213 kW for the IMO Tier III emissions standard. This portfolio will be continuously expanded to include other power outputs.

www.engines.man.eu

New MTU hybrid propulsion systems

In 2020, Rolls-Royce plans to launch a range of integrated MTU hybrid ship propulsion systems that will also be made available for yachts, workboats, ferries and patrol boats in a power range extending from about 1000 to 4000 kW per power train and the company is planning to test a new MTU hybrid system incorporating Series 2000 engines in a yacht in 2019.

"The combination of diesel engines and electric motors, in addition to batteries, will offer our customers significant benefits in a variety of marine applications, the most important being efficiency, environmental compatibility and the flexibility of the propulsion system applications," said Knut Müller, head of MTU's Marine and Government business. With the aid of a modular system, we will make available integrated hybrid propulsion systems that are tailored to the customer's specific requirements."

Rolls-Royce will be offering complete hybrid propulsion systems from MTU for ships, consisting of MTU internal combustion engines, electric drive modules, transmission systems, batteries, monitoring and control systems, and other electronic components.

The systems will be offered in a variety of power ranges to suit individual customer requirements. As of 2020, systems incorporating MTU Series 2000 engines combined with one or two elec-

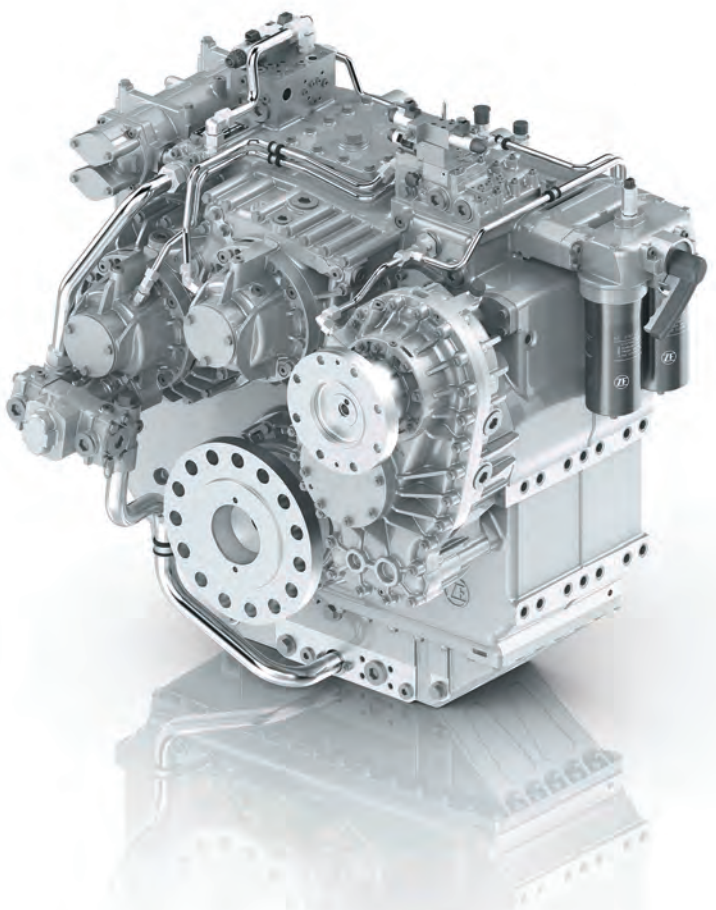


Photo:ZF Friedrichshaven AG

With its modular design, the new ZF 8000 marine transmission series gives manufacturers and fleet operators greater flexibility in maneuvering their vessels. Shown here is the ZF 8300 PTI unit.

Rolls-Royce has introduced a new podded propulsion system. The ELegance pods, one with an open propeller, the other ducted, complement and complete the company's portfolio of mechanical and electric propulsion systems.

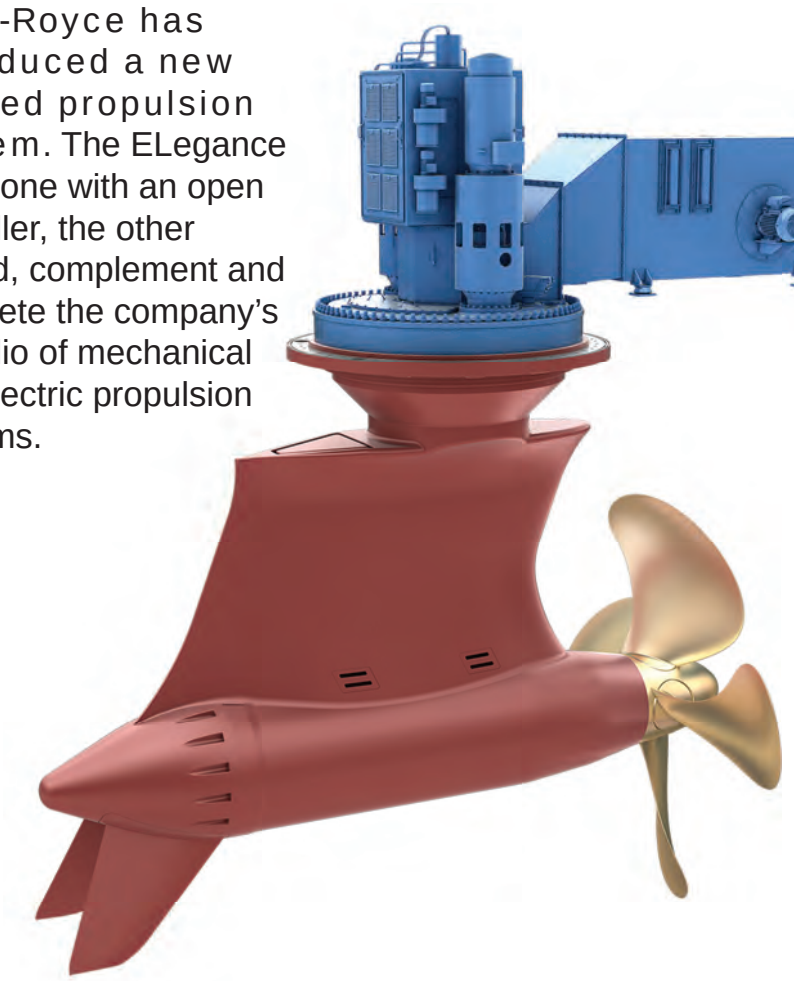


Photo: Rolls-Royce Marine

tric motors per power train, each with 150 kW of electrical output, will be launched on the market and will cover a power range of between about 1000 and 2200 kW per power train. As of 2021, MTU will then extend its portfolio with the addition of hybrid systems based on the power delivered by MTU Series 4000 engines and as many as four electric motors, each with 150 kW of electrical output, and will cover a power range of between about 1000 and 4000 kW per power train.

www.rolls-royce.com/products-and-services/marine

ZF unveils new ZF 8000 Transmission series

ZF introduced a new marine transmission series, the ZF 8000 model range, for outputs up to a maximum of 3000 kW. The new series is available in multiple transmission ratios, housing sizes and variants to give a high degree of flexibility for newbuild projects and retrofits, covering a wide range of vessel types from coast guard vessels and yachts to ferries, supply ships and small tankers. A special feature of the new transmission system is that an additional power intake makes it possible to integrate an electric motor for hybrid functions.

The ZF 8000 series fulfills the current requirements of international classification societies and has been designed with potential future regulations in mind. This advanced transmission features a high power density, a robust housing and an optimized power-to-weight ratio and is designed to meet a wide variety of customer-specific requirements. In addition, with its optional subshaft, the ZF 8000 can be coupled with an electric drive, enabling vessels to maneuver with a zero fuel requirements and zero emissions.

ZF is planning to make prototypes of the ZF 8000 marine transmission series available in the first quarter of 2019.

www.zf.com

New Rolls-Royce Podded Propulsion Range

Rolls-Royce introduced ELegance, a new podded propulsion system designed to meet market demand for smaller, more compact units. The ELegance pods, one with an open propeller, the other ducted, complement and complete the company's portfolio of mechanical and electric propulsion systems. Per Nahnfeldt, General Manager Product – Electric Propulsion, Rolls-Royce, said: "For many years we have recognized the gap in the propulsion market for smaller pods, including ice-class, in the 1.5 MW to 7 MW power range. These new pods – based on our Permanent Magnet technology – complement our broad product portfolio and sit well with our range of frequency drives and electrical systems. We can now provide a complete fully-electric propulsion package."

The use of permanent magnet (PM) motors in podded propulsion provides a high motor efficiency over all speed ranges. Their use also results in a pod that optimizes the trade-off between electric, mechanical and hydrodynamic efficiency.

"The pods feature a 'twin-tail' concept to further improve efficiency while significantly reducing cavitation-induced noise and vibra-

Photo: ABB

SKF's retractable fin stabilizers, combined with the company's new SKF Dynamic Stabilizer Cover system designed to reduce drag at the fin box openings and reduce fuel consumption for the vessel by more than 1%, will result in a system that is fully adaptable to the ship's speed, sea state and vessel roll motion, with selectable single- or twin-fin deployment of ±60° working angle in zero-speed mode.

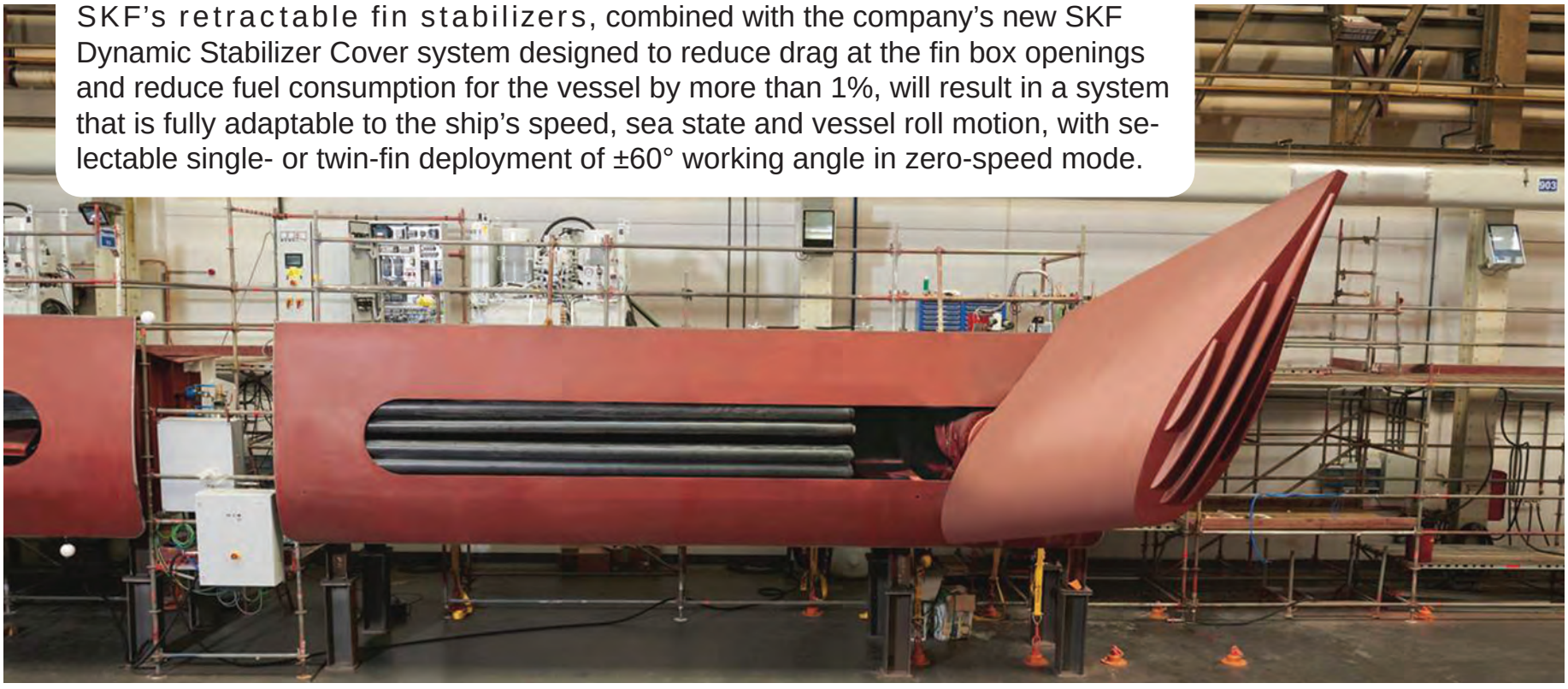


Photo: SKF

tion," said Nahnfeldt. "A new integrated hull-fitting interface also allows a compact head-box to be used, which minimizes drag and further improves hull efficiency." Rolls-Royce is now building a 4.6 MW ELegance pod at its Rauma facility in Finland and is in discussions with shipowners about installing the pod in a pilot project.

www.rolls-royce.com/products-and-services/marine

Autonomous Shipping: Next-Gen DP from ABB

ABB launched a new dynamic positioning (DP) system, the ABB Ability Marine Pilot Control, designed to simplify ship maneuvering with an intuitive touchscreen-based user interface and thereby enable safer, more efficient ship operations. With its user-centric design, the new DP system reduces the workload on automating navigational tasks and allows bridge officers to focus holistically on the overall control and positioning of the ship. The system integrates seamlessly with existing onboard equipment with the intention of adding significant 'bridge-to-propeller' value for shipowners. According to ABB, one of the key benefits of the new system is that it allows operators to switch to joystick control for maneuvering vessels at any speed and all the way to docking: the ABB Ability Marine Pilot Control employs algorithms that calculate the optimal way of executing a command for controlling a vessel in any operational situation and the overall safety of that operation is increased because the crew is able to maintain full situational awareness rather than having to focus on changing control modes. The system has obtained a Lloyd's Register's Approval in Principle (AiP) certificate.

www.abb.com

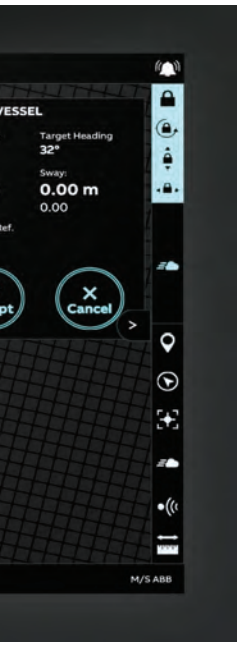
SKF Type Z stabilizers chosen for Norwegian research vessel

SKF has won a $2.6 million order to deliver two pairs of retractable fin stabilizers, including novel dynamic stabilizer covers, for a 182.9-m research expedition vessel currently being fitted out at a Norwegian shipyard. The ship, the world's largest research expedition vessel, which is due to be launched in 2020, will carry a team of international researchers and will be equipped for research and investigation into the entire marine ecosystem. SKF's retractable fin stabilizers, combined with the company's new SKF Dynamic Stabilizer Cover system designed to reduce drag at the fin box openings and reduce fuel consumption for the vessel by more than 1%, will result in a system that is fully adaptable to the ship's speed, sea state and vessel roll motion, with selectable single- or twin-fin deployment of ±60° working angle in zero-speed mode.

The SKF Dynamic Stabilizer Cover design comprises two specially shaped air cushions fitted to the top and bottom of the fin box with small steel rails. In normal operation, the cushions are inflated using compressed air from the vessel's existing pneumatic systems: when inflated, the cushions form a smooth, streamlined cover over the fin box opening to achieve a significant reduction in drag.

When the stabilizer fin is to be extended or retracted, air is released from the cushions, which are then deflated by the water pressure outside the hull, creating room for the fin's movement. The cushions can be re-inflated when deployment or housing is complete. Control of the covers is fully integrated into the stabilizer fin control systems, and requires no additional action by the crew.

www.skf.com



With its user-centric design, the new ABB Ability Marine Pilot Control dynamic positioning (DP) system reduces the workload on automating navigational tasks and allows bridge officers to focus holistically on the overall control and positioning of the ship.

Photo:SICK AG

Industrial sensor specialist SICK AG has received Type Approval from Lloyd's Register for its MARSIC300 ship emissions measuring device, which now makes it the most approved emissions measuring device on the market.

Photo: Rolls-Royce Marine

Rolls-Royce's new fin stabilizer design has a reduced fin area and optimized lower fin angle to meet stabilization performance requirements and also reduces dynamic drag when deployed underway, leading to lower fuel costs.

MARSIC300 receives Type Approval from Lloyd's Register

Waldkirch-im-Breisgau, Germany-headquartered industrial sensor solutions specialist SICK AG has received Type Approval from Lloyd's Register of Shipping for its MARSIC300 ship emissions measuring device. The product has now received Type Approval from a total of seven classification societies, making it the most approved emissions measuring device on the market. The MARSIC300 is a maintenance-free device developed specifically for measuring maritime emissions of both SOx and carbon dioxide upstream and downstream of scrubbers in addition to NOx upstream and downstream of SCR systems.

The MARSIC300 does not need to be calibrated with gas as it is equipped with a certified calibration filter.

www.sick.com

New Rolls-Royce Stabilizer Range

Rolls-Royce introduced new versions of its stabilization systems to add the potential for ice-class ships to benefit from the company's 'stabilization-at-rest' (SAR) concept. The system, which is incorporated into both the Aquarius and Neptune ranges of Rolls-Royce retractable stabilizers, employs active fin control technology and advanced hydrodynamic design to deliver higher levels of roll reduction when a vessel is at rest and maintain stabilization performance whilst underway.

In the new design, the stabilizer fins can be fully retracted into the custom-designed fin box so that there are no protrusions from the hull form, thereby ensuring safe navigation through ice. The new design has a reduced fin area and optimized lower fin angle to meet stabilization performance requirements and also reduces dynamic drag when deployed underway, which leads to lower fuel costs.

The stabilizer fin incorporates Rolls-Royce's trailing-edge design, eliminating vibration and noise. Recognizing that the Rolls-Royce ice-class SAR stabilizers are likely to be employed on vessels sailing in environmentally sensitive areas, a special quad-seal arrangement ensures minimal risk of leakage, and the machinery is fully compatible with a wide range of environmentally acceptable lubricants (EALs).

www.rolls-royce.com/products-and-services/marine

Langh Scrubbers for 12 NORDEN Vessels

Langh Tech said it will deliver SOx scrubber systems for a dozen vessels owned by Danish shipowner Dampskibsselskabet NORDEN A/S, marking the Finnish scrubber manufacturer's largest deal so far.

Langh Tech Oy Ab will supply for retrofit four tankers and eight bulk carriers in the NORDEN- fleet with SOx scrubbers of open loop-type.

The tankers have two boilers and a total of six exhaust gas sources are connected to the scrubber. Automation enables the scrubber plant to be operated in two exhaust gas cleaning modes corresponding to 0.1 or 0.5 percent sulphur in the fuel. This means compliance for the vessels with as well ECA and global regulations regarding SOx emissions.

The scrubbers will be of in-line type and replacing the silencers. Dry running of the scrubbers is possible, eliminating the need of bypass for the main engine. All auxiliaries will have bypass.

www.langh.fi

Langh Tech will deliver SOx scrubbers for a dozen vessels owned by Danish shipowner Dampskibsselskabet NORDEN A/S.

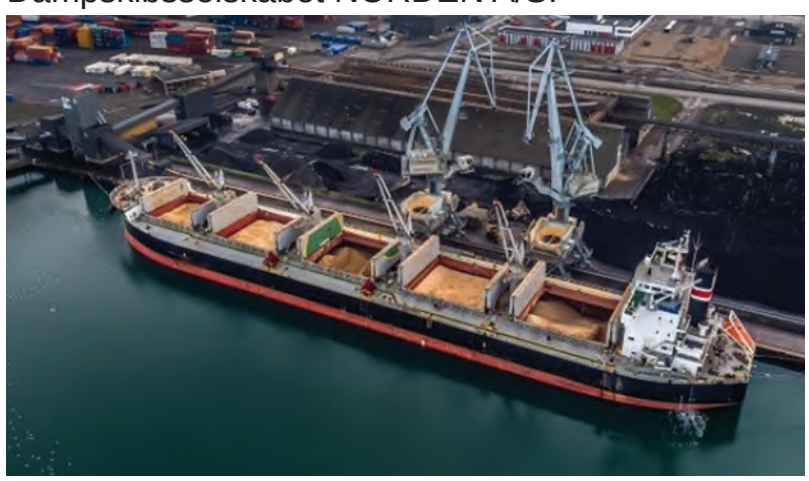


Photo: © Dampskibsselskabet NORDEN

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Marine Exhaust Systems of Alabama, 757 Nichols Ave., Fairhope, AL , USA , tel:(251) 928-1234, mark@mesamarine.com , www.mesamarine.com

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Advanced Power Systems / Fitch Fuel Catalyst, 18 Hemlock Drive New Hartford, CT.06057 , USA , tel:860-921-0009, info@fitchfuelcatalyst.com , www.fitchfuelcatalyst.com

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NAVAL ARCHITECTS, MARINE ENGINEERS

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Gilbert Associates, 100 Grossman Dr. Suite 205 Braintree, MA 02184 USA , tel:(781) 740-8193, jgilbert@jwgainc.com contact: John Gilbert, www.jwgainc.com

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Dockmaster

Colonna's Shipyard, Inc.
Full Time , Company Employee
Category: Shoreside Operations
Job Location: 400 East Indian River Road Norfolk, VA, 23523 United States
Contact
Director of Human Resources
Email: kwong@colonnaship.com
Work Phone : 757-545-2414
400 East Indian River Road Norfolk, VA, 23523 United States
Description:
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Maritime College
Full Time
Category: Shipboard Officer / Personnel / Crew
Job Location: Throggs Neck, New York, 10465 United States
Contact
Email: none@given.com
Work Phone : 888-888-8888
Apply Online Bronx, NY, 10465 USA
Description:
Lecturer/Relief Captain
About SUNY Maritime College:
SUNY Maritime College located on a 55-acre scenic waterfront property on the outskirts of New York City on the Throggs Neck peninsula where the East River meets Long Island Sound. The campus blends the best of two worlds: a comfortable college-town feel with the greatest city in the world. An impressive view of the sound extends toward the North Atlantic, yet only a few miles away are Yankee Stadium and midtown Manhattan. SUNY Maritime offers an array of employment opportunities stemming from entry level to professional positions which encourage growth and development among its employees.

Master Mariner

Rigel Shipping Canada Inc
Full Time , Company Employee
Category: Vessel Operations
Skills:
Must have Transport Canada Documents
Master Mariner
Advanced Tanker training
Advanced Chemical training (an asset)
SSO
ECDIS
BRM
Transport Canada Medical
GMDSS
Description:
We have a permanent position available we have 3 Oil/Chemical Tankers
Benefits are paid after 90 days
Health/Dental/LTD
RRSP paid at 7%
We pay day for day approximately 49 days on and 49 days at home.

Commercial Analyst, Marine Products

Wilhelmsen Ships Service
Full Time , Mid Career
Job Location: Pasadena, Texas, United States
Contact
HR Generalist
Email: Colleen.Martin@wilhelmsen.com
Work Phone : 214.938.5429
Staten Island, New York, United States
Description:
Wilhelmsen is a global maritime industry group founded in 1861. We are a global maritime industry group, and a leader within our industry. We deliver products and services to practically anywhere you have a ship or a maritime related industry. With offices in 125 countries, supporting our non-stop operations in 2,200 port locations across the globe Wilhelmsen Ships Service (WSS) has the largest maritime services network in the world. Wilhelmsen supplies a wide portfolio of maritime products (Unitor™, Timm™ and Nalfleet™ branded solutions) worldwide to every conceivable vessel type, in every market and region, if it floats it has probably benefitted from our expertise in port, onboard, or offshore.

Project Manager - Gas Turbine

VSE Corporation
Full Time , Project Manager
Category: Project Engineering / Project Management
Description:
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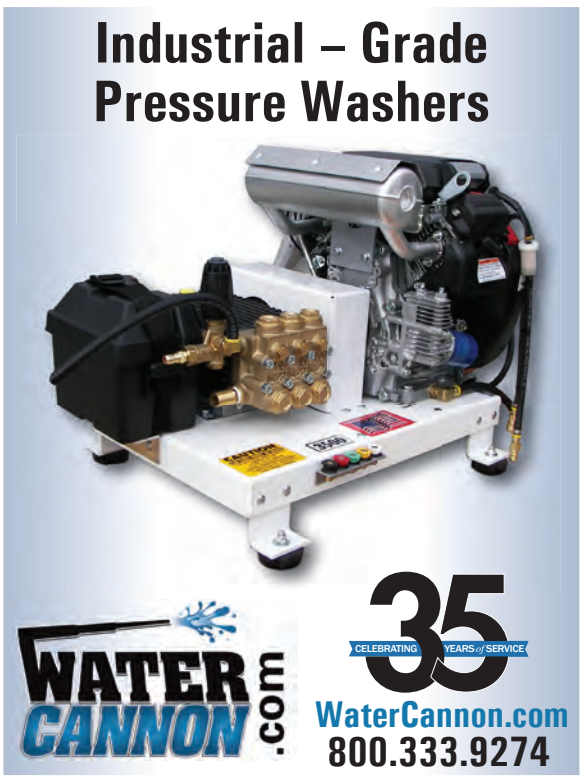
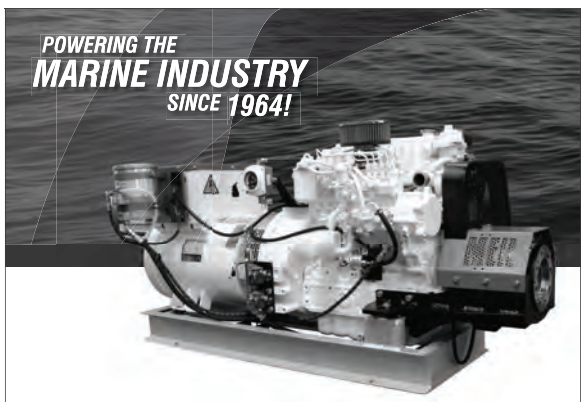
Government Inventory Control Manager

Salary: $ 65,000-75,000 annually , Full Time , Project Manager
Category: Shoreside Operations
Job Location: Newport News, Virginia, 23602 United States
Contact
HR Manager
Email: arubin@hroptions.com
Willow Pass Road Concord, California, 94520
Description:
Patriot Contract Services, LLC is a ship management company providing operations contract services to government and commercial vessels including MARAD and the Military Sealift Command. This is a full time position offering a competitive salary and benefits.

Electrical Engineer

Blount Boats
Salary: $ 50-60,000 , Full Time , Engineer
Category: Engineer / Naval Architect
Job Location: P.O. BOX 368 Warren, RI, 02885 USA
Contact
Email: julie@blountboats.com
Work Phone : 4012458300
P.O. BOX 368 Warren, RI, 02885 USA
Duties/responsibilities:
• Provide engineering services during proposal, design, and construction stages for vessel projects, with strict adherence to contract specifications.
• Prepares the design of electrical drawings & vessel load analysis for submission to USCG or ABS.





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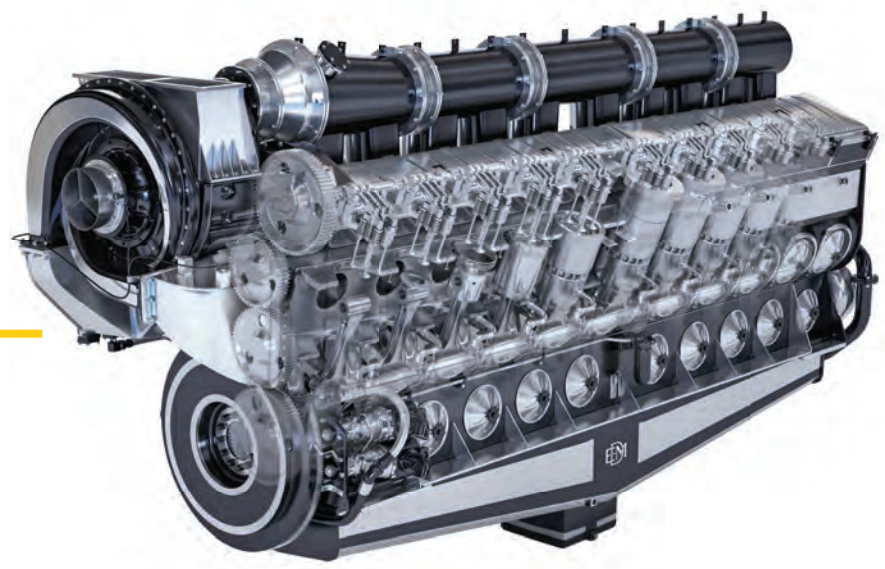

The E 23 (IMO II-EPA T3) and E 23B (IMO III-EPA T4F) are available in 8, 12, 16 and 20 cylinder configurations with power ratings from (1675 hp) to (5500 hp).

*"Please consult MSI for specific application ratings"

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- Ample power margin throughout the entire operating speed range allows for optimized engine sizing and a single speed reduction gear.
- Avoids engine lugging under demanding vessel maneuvers.
- Accepts 100% block load in constant speed applications.

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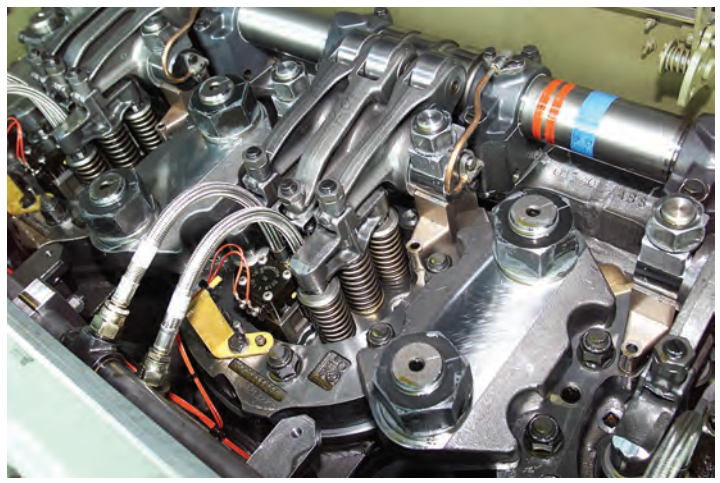

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- Easy non-invasive inspection of cylinder components for simple predictive condition-based maintenance.
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- No oil change required between overhauls unless indicated by oil sample analysis.
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